CSO! Clean Solutions for Omaha

City of Omaha, Nebraska
Jean Stothert, Mayor

2021 Update to the Long Term Control Plan for the Omaha Combined Sewer Overflow Control Program

March 2021

Update to the Long Term Control Plan for the Omaha Combined Sewer Overflow Control Program

Prepared for

City of Omaha

CSO!
Clean Solutions for Omaha

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Acronyms and Abbreviations / Terms

°C	degree(s) Celsius
1D	one-dimensional
2009 LTCP	City of Omaha. 2009. *City of Omaha Long Term Control Plan for the Omaha Combined Sewer Overflow Control Program.*
2011 Flood	2011 Missouri River Flood
2014 LTCP Update	City of Omaha. 2014. *Update to Long Term Control Plan for the Omaha Combined Sewer Overflow Control Program.*
2019 Flood	2019 Platte River and local tributaries and Missouri River Flood
BMP	best management practice
BOD	biochemical oxygen demand
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (aka Superfund)
cfs	cubic feet per second
cfu/100 mL	coliform unit(s) per 100 milliliters
CIP	Capital Improvements Plan
CIPP	cured-in-place pipe
City	City of Omaha
CMOM	Capacity Management, Operations, and Maintenance
CSO	combined sewer overflow
CSS	combined sewer system
CTS	Collector Tunnel System
CWA	Clean Water Act
DS	Drop Shaft
DTS	Deep Tunnel System
DWF	dry-weather flow
EEIT	Economic Equity and Inclusion Team
ENRCCI	Engineering News-Record Construction Cost Index

EPA	United States Environmental Protection Agency
FCA	Financial Capabilities Assessment
FEMA	Federal Emergency Management Agency
GIS	geographic information system
HEC-RAS	Hydrologic Engineering Center's River Analysis System software
hr	hour(s)
HGL	hydraulic grade line
HPA	high-performing alternative
I/I	inflow and infiltration
JCB	John A. Creighton Boulevard
JDS	Joint Drop Shaft
LF	linear foot
LIHEAP	Low Income Heat and Energy Assistance
LTCP	Long Term Control Plan
MG	million gallons
mg/L	milligrams per liter
MGD	million gallon(s) per day
MHI	Median Household Income
mL	milliliter(s)
MLRS	Minne Lusa Relief Sewer
MPN	most probable number
MRW	Missouri River Watershed
MRWRRF	Missouri River Water Resource Recovery Facility
MS4	Municipal Separate Stormwater Sewer System
M.U.D.	Metropolitan Utilities District
N/A	not applicable
NDEE	Nebraska Department of Environment and Energy
NDOT	Nebraska Department of Transportation
NDNR	Nebraska Department of Natural Resources

NET	Nebraska Environmental Trust
NMC	Nine Minimum Controls
NPDES	National Pollutant Discharge Elimination System
NPV	net present value
NSF	near-surface facility
NTS	Non-Tunnel Solution
O&M	operations and maintenance
OPCC	opinion of probable construction costs
OPPD	Omaha Public Power District
ORE	overflow reduction effectiveness
PCMP	Post Construction Monitoring Plan
PCN	Papillion Creek North Basin
PCW	Papillion Creek Watershed
PCWRRF	Papillion Creek Water Resource Recovery Facility
PMRNRD	Papio-Missouri River Natural Resources District
PMT	Program Management Team
PRPP	City of Omaha Parks, Recreation, and Public Property Department
RI	Residential Indicator
RTB	retention treatment basin
RTC	real-time control(s)
SCRTB	Saddle Creek Retention Treatment Basin
SIFM	South Interceptor Force Main
SOIs	Solutions of Interest
SOIA	South Omaha Industrial Area
SOIASS	South Omaha Industrial Area Sewer Separation
SRF	State Revolving Fund
STS	Short Tunnel System
TACS	Technical Assessment for Cost Savings
TKN	total Kjeldahl nitrogen

TM	Technical Memorandum
TMDL	total maximum daily load
TRC	total residual chlorine
TSS	total suspended solids
UPRR	Union Pacific Railroad
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
VE	Value Engineering
VFD	variable frequency drive
WIFIA	Water Infrastructure Finance and Innovation Act
WRRF	Water Resource Recovery Facility
WRRF Master Plan	City of Omaha. 2021. *Water Resource Recovery Facility (WRRF) Master Plan*
WWOP	Wet Weather Operations Plan

Glossary

Active Control – At a CSO diversion, this is a control that is operated either automatically or manually to respond to specified conditions, such as a sluice gate being operated to regulate a CSO discharge during wet weather. Compare to Passive Control.

Adaptive Management Approach – As defined by the EPA, is "the process by which new information about the health of a watershed is incorporated into the watershed management plan." The City of Omaha has applied this process to the CSO LTCP and implementation of individual controls within the LTCP by continually evaluating existing controls, identifying new potential controls, and determining the most cost effective way to achieve water quality objectives.

Best Management Practice – Methods that have been determined to be the most effective, practical means of preventing or reducing pollution from non-point sources. Usually used to refer to stormwater controls.

Biochemical Oxygen Demand (BOD) – A measure of the amount of oxygen consumed in the biological processes that break down organic matter in water. The greater the biochemical oxygen demand, the greater the degree of pollution.

Capture (Percent Capture) – The percentage by volume of combined sewer flow in the combined sewer system that receives treatment or is otherwise controlled.

Clean Water Act – An act passed by the US Congress to control water pollution. The Federal Water Pollution Control Act passed in 1972 (Public Law [PL] 92-500). It was amended in 1977 (the Clean Water Act, PL 95-217) and again in 1987 (the Water Quality Act, PL 100-4).

Combined Sewer Overflow (CSO) – Discharge of a mixture of stormwater and domestic/industrial/commercial wastewater. The overflow occurs when the flow capacity of a combined sewer system is exceeded during a storm event.

CSO Control Policy – EPA's CSO Control Policy is a national framework for control of CSOs through the National Pollutant Discharge Elimination System (NPDES) permitting program. The Policy resulted from negotiations among municipal organizations, environmental groups, and State agencies. It provides guidance to municipalities and state and federal permitting authorities on how to meet the Clean Water Act's pollution control goals as flexibly and cost effectively as possible (http://water.epa.gov/polwaste/npdes/cso/). The Policy has since been incorporated into the CWA through the Wet Weather Water Quality Act of 2000.

Combined Sewer System (CSS) – A sewer system that carries both sewage and stormwater runoff. Normally, the entire flow goes to a water resource recovery facility, but during a heavy storm, the volume of water may be so great as to cause overflows of untreated mixtures of stormwater and sewage into receiving waters.

Combined Sewer System Model (CSS Model) – A comprehensive Model, organized into three model elements: hydrologic runoff to simulate wet weather flow, dry-weather flow to simulate sanitary flows, and the hydraulic collection system to simulate the separated and combined sewer systems.

Community Enhancements – Efforts undertaken by either the City of Omaha or a neighborhood to implement positive green and/or aesthetic changes during the planning and construction of a CSO Project. Such enhancements may include tree planting and landscaping, installing or replacing sidewalks, and incorporating public art into an area.

Deactivated CSO – Combined sewer overflow location which no longer discharges from the combined sewer system.

Detention – The delay or holding of the flow of water and/or water-carried wastes in a pond, detention basin, storage tank, or pipe system. Detention also means the time water is held or stored in a basin or a wet well.

Dewater –The draining or removal of water or combined sewage from a tank or RTB.

Disinfection – The process designed to kill or inactivate most microorganisms in water or wastewater, including essentially all pathogenic (disease-causing) bacteria. There are several ways to disinfect, with chlorination being the most frequently used in water treatment plants and wastewater resource recovery facilities.

Dissolved Oxygen – The oxygen freely available in water, vital to fish and other aquatic life and for the prevention of odors. Dissolved oxygen levels are considered the most important indicator of a water body's ability to support desirable aquatic life. Water resource recovery facilities are designed to remove waste materials that consume dissolved oxygen to prevent excessive consumption in receiving waters.

Diversion Structure (Chamber) – A chamber or box that contains a device for diverting or drawing off all or part of a flow for discharging portions of the total flow to various outlets.

Drop Shaft – A vertical opening used to provide access to a tunnel.

***Escherichia coli* (*E. coli*)** – One of the species of bacteria in the fecal coliform group. It is found in large numbers in the gastrointestinal tract and feces of warm-blooded animals and man. Its presence is considered indicative of fresh fecal contamination, and it is used as an indicator organism for the presence of less easily detected pathogenic bacteria.

Existing Conditions – The combined sewer system as it was configured in the year 2002, which is the year the City of Omaha's first CSO National Pollutant Discharge Elimination System permit was issued by the Nebraska Department of Environment and Energy.

Floatables Control – Technologies designed to reduce or eliminate the visible solid waste that is often present in CSO discharges.

Force Main – A pressure pipe joining the pump discharge at a water or wastewater pumping station with a point of gravity flow.

Gravity Flow (Sewer) – Water or wastewater flowing from a higher elevation to a lower elevation by the force of gravity. The water does not require the energy provided by a pump to flow. Wherever possible, wastewater collection systems are designed to use the force of gravity to carry waste liquids and solids.

Green Infrastructure – Green infrastructure uses natural systems and or engineered systems designed to mimic natural processes to manage urban stormwater. These systems are often soil or vegetation-based and include planning approaches such as tree preservation and impervious cover reduction, as well as structural interventions such as rain gardens and permeable pavements. By maintaining or restoring the hydrologic function of urban areas, green infrastructure treats precipitation as a resource rather than waste.

Grit Removal – Grit removal is accomplished by providing an enlarged channel or chamber that causes the flow velocity to be reduced and allows the heavier grit to settle to the bottom of the channel where it can be removed.

Groundwater Infiltration – The quantity of groundwater that leaks into a pipe through joints, porous walls, or cracks.

Headworks – The initial structures and devices of a water treatment plant or water resource recovery facility.

High-Rate Treatment – Treatment processes intended to provide a treatment level equivalent to primary treatment, as required by U.S. Environmental Protection Agency's CSO Control Policy, plus disinfection to achieve an effluent quality of 126 *E. coli* coliforms per 100 milliliters. Alternative high-rate treatment processes are sand ballasted sedimentation or retention treatment basins.

Lift Station – A structure that contains pumps and appurtenant piping, valves, and other mechanical and electrical equipment for pumping water, wastewater, or other liquids. Also called a pumping station.

Missouri River Watershed – The watershed that includes those study basins where the combined sewage flows through sewers and is ultimately pumped to the MRWRRF.

National Pollutant Discharge Elimination System (NPDES) Permit – the regulatory agency document issued by either a federal or state agency that is designed to control all discharges of potential pollutants from point sources including stormwater runoff into U.S. waterways. NPDES permits regulate discharges into U.S. waterways from all point sources of pollution, including industries, municipal wastewater treatment plants, sanitary landfills, large animal feedlots, and return irrigation flows.

Nine Minimum Controls – includes minimum technology-based controls that can be used without extensive engineering studies or significant construction costs, prior to the implementation of long-term controls.

Operationally Complete – When a wet weather facility project is substantially complete, is ready for its intended use, and has been made ready to operate by the City.

Papillion Creek Watershed – The watershed that includes those study basins with combined sewers that flow into the Papillion Creek Interceptor and to the Papillion Creek WRRF.

Preliminary Treatment – Unit operations, such as screening, comminution, and grit removal, that prepare the wastewater for subsequent major treatment.

Presumption Control Level (Approach) – an approach that meets one or more of the presumption approach criteria as defined by the U.S. Environmental Protection Agency CSO

Control Policy. The presumption approach means either the capture of at least 85 percent by volume, on average annually, of the combined sewage entering the collection system during wet weather, or no more than four to six untreated overflows during an average year.

Primary Treatment – The first major treatment in a water resource recovery facility, used for the purpose of sedimentation. Wastewater treatment processes usually consist of clarification with or without chemical treatment to accomplish solid-liquid separation.

Program – The effort to implement the LTCP for the City of Omaha. Also called the CSO Program.

Program Management Team – The members of the City, Jacobs Engineering Group Inc., Emspace + Lovgren, and HDR Engineering Inc. who are working on the CSO Program.

Representative Year – The year (1969) selected for evaluating CSO controls, based on statistical analysis of historic precipitation data from Eppley Airfield and representing approximately average precipitation conditions.

Retention Treatment Basins – Large settling basins to which chemicals are added for disinfection and dechlorination. During smaller wet weather events, the entire CSO volume will be captured and dewatered to an existing wastewater resource recovery facility. During larger events, the basins will discharge treated water to receiving streams.

Sanitary Sewer – A sewer that carries liquid and waterborne wastes from residences, commercial buildings, industrial plants, and institutions, together with minor quantities of ground, storm, and surface water that are not admitted intentionally, to a wastewater resource recovery facility for treatment.

Screen – A device with openings, generally of uniform size, used to retain or remove suspended or floating solids in a flow stream, preventing them from passing a given point in a system. The screening element may consist of parallel bars, rods, wires, grating, wire mesh, or perforated plates.

Secondary Treatment – Sometimes used interchangeably with the concept of biological wastewater treatment, particularly the activated-sludge process. Commonly applied to treatment that consists chiefly of clarification followed by a biological process with separate sludge collection and handling.

Storm Sewer – A sewer that carries only storm flow.

Stormwater Runoff – Water flowing over land during and immediately following a rainstorm or snowmelt. Stormwater carries nutrient laden sediment, heavy metals, oils, and other materials that have accumulated on the land between rain events and flushes them into streams, rivers, and lakes.

Sustainability – The three primary components of sustainability as they relate to CSO Program goals are economic growth, environmental stewardship, and public acceptance

Total Maximum Daily Load – A Total Maximum Daily Load (or TMDL) is a calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources.

Total Suspended Solids – A measure of the suspended solids in wastewater, effluent, or water bodies, determined by tests for “total suspended non-filterable solids”.

Watershed – The region or land area that contributes to the drainage or catchment area above a specific point, such as a water resource recovery facility or a point on a stream.

Wet Well – A compartment or tank in which wastewater is collected. The suction pipe of a pump may be connected to the wet well or a submersible pump may be located in the wet well.

References

City of Omaha. 2007. *Nine Minimum Controls Plan.* October 1.

City of Omaha. 2009. *City of Omaha Long Term Control Plan for the Omaha Combined Sewer Overflow Control Program*. September.

City of Omaha. 2014. *Update to Long-Term Control Plan for the Omaha Combined Sewer Overflow Control Program*. October.

City of Omaha. 2018. *Technical Assessment for Cost Savings*.

City of Omaha. 2019. City of Omaha Combined Sewer Overflow Annual Report NPDES Permit No. NE0133680, October 1, 2018 through September 30, 2019. December 20.

City of Omaha. 2021. *Water Resource Recovery Facility (WRRF) Master Plan.*

Nebraska Department of Environmental Quality (NDEQ). 2008. *2008 Water Quality Integrated Report.* March.

Nebraska Department of Environmental Quality (NDEQ). 2009. T*otal Maximum Daily Loads for the Papillion Creek Watershed (Segments MT1-10100, MT1-10110, MT1-10111.1, MT1-10120 and MT1-10200), Parameter of Concern: E. coli Bacteria.* Environmental Quality Planning Unit, Water Quality Division. October.

Nebraska Department of Environmental Quality (NDEQ). 2014. *2014 Water Quality Integrated Report.* April 1.

Nebraska Department of Environmental Quality (NDEQ). 2015. *NPDES Permit Number NE0133680 for the City of Omaha*. September 28.

Nebraska Department of Energy and Environment (NDEE). 2020. *2020 Water Quality Integrated Report.*

Nebraska Department of Environment and Energy (NDEE). 2019. *Title 117 – Nebraska Surface Water Quality Standards.* June 24.

City of Omaha Program Management Team (PMT). 2018. *Technical Memorandum: Selection of a Proxy Period for Omaha CSO Program Optimization.*

City of Omaha Program Management Team (PMT). 2020a. *Technical Memorandum: Optimization Decision Factors for HPA Selection.*

City of Omaha Program Management Team (PMT). 2020b. *Technical Memorandum: Environmental Assessment of HPAs.* October 12.

City of Omaha Program Management Team (PMT). 2020c. *Technical Memorandum: Optimization Technical Assessments – Update of HPA Land Acquisition, Easement, and Site Development Data.* October 6.

U.S. Army Corps of Engineers (USACE). 2007. *U.S. Army Corps of Engineers-Omaha District, Missouri River Floodway Study Model.* November.

United States Environmental Protection Agency (EPA). 1995a. *Combined Sewer Overflows-Guidance for Long Term Control Plan.*

United States Environmental Protection Agency (EPA). 1995b. *Combined Sewer Overflows-Guidance for Nine Minimum Controls.* EPA Document 832-B-95-003. May.

United States Environmental Protection Agency (EPA). 2012. *CSO Post Construction Compliance Monitoring Guidance*. May.

Executive Summary

The City of Omaha (City), in compliance with the requirements of the Clean Water Act, United States Environmental Protection Agency (EPA) Combined Sewer Overflow (CSO) Control Policy of 1994, and its Administrative Consent Order with the Nebraska Department of Environment and Energy (NDEE)[1], developed a plan to control overflows from its combined sewer system (CSS). This plan was presented in detail in the document entitled *City of Omaha Long Term Control Plan for the Omaha Combined Sewer Overflow Control Program* (City of Omaha, 2009). This is the second update to the 2009 Long Term Control Plan (LTCP; City of Omaha, 2009), which was submitted to NDEE in September 2009 and approved February 2010. Implementation of the CSO controls in the 2009 LTCP started in the summer of 2009 and is ongoing. Subsequently, on September 29, 2014, an update to the 2009 LTCP was submitted to NDEE and approved on January 23, 2015. That update is referred to as the 2014 LTCP Update (City of Omaha, 2014). The 2014 LTCP Update has been modified several times over the last 5 years.

This 2021 LTCP Update to the City's LTCP is in compliance with the City's CSO Permit (National Pollutant Discharge Elimination System [NPDES] Permit No. NE0133680) (NDEQ, 2015) and Complaint and Compliance Order by Consent (Consent Order), which was last modified on October 16, 2019. The City's current CSO Permit and the Consent Order require an updated LTCP be submitted by March 31, 2021.

This document (2021 LTCP Update) describes the update process, presents the results of new evaluations, summarizes the outcome of the update effort, and recommends improvements in the CSO controls as an outcome of the City's adaptive management approach. It also provides information on the status of LTCP implementation.

This Executive Summary provides a brief overview of the 2021 LTCP Update and makes reference to sections of the LTCP Update report. Because the 2021 LTCP Update builds upon the 2009 LTCP and 2014 LTCP Update rather than replacing them, the previous LTCPs should be consulted for additional information.

The LTCP Update process, and the information presented in the report, demonstrate that the goals of the 2009 LTCP and the requirements of the Clean Water Act and EPA CSO Control Policy are being met by the City.

ES.1 Introduction

The LTCP 2021 Update report consists of the following sections:

- Section 1 – Introduction
- Section 2 – Current Status of the Program
- Section 3 – Evaluation of Alternatives
- Section 4 – Program Financing and Financial Considerations

[1] Formerly the Nebraska Department of Environmental Quality (NDEQ)

- Section 5 – Updated CSO Controls
- Section 6 – LTCP Schedule
- Section 7 – Public Involvement
- Section 8 – Post Construction Monitoring Plan
- Section 9 – Wet Weather Operations Plan

In addition, a Glossary of terms and several appendixes supplement information presented in this report. The appendixes are listed below:

- Appendix A: Post Construction Monitoring Plan
- Appendix B: Wet Weather Operations Plan
- Appendix C: Water Quality Model Technical Memorandum
- Appendix D: Agency Letters (Letters to and from Governmental Agencies regarding Endangered Species and Drinking Water Intakes for determination of Sensitive Areas)
- Appendix E: Optimization of CSO Controls Report
- Appendix F: Vetting of High-Performing Alternatives Technical Memorandum
- Appendix G: High-Performing Alternatives Concept and Cost Verification Technical Memorandum
- Appendix H: City of Omaha Sanitary Sewerage Revenue Refunding Bonds Documentation

The City developed the 2021 LTCP Update in compliance with the requirements of the EPA CSO Control Policy (59 Federal Register 18688); the August 8, 2007 Complaint and Compliance Order by Consent (Consent Order) as amended in 2019 (Amended Consent Order); and the City's NPDES permit for the CSS.

In 2009, 29 CSO outfalls were permitted by NDEE to discharge during wet weather from the City's CSS: 19 to the Missouri River and 10 to tributaries of Papillion Creek. Since that time, four of these outfalls (CSOs 104, 113, 207, and 209) have been deactivated or converted to stormwater only, although one remains in the current NPDES permit until its renewal in 2021. CSO 207 remains in the current NPDES Permit until its renewal in 2021. Two additional outfalls, CSOs 103 and 208, have had separation projects completed and are in a monitoring phase. The City anticipates permanent deactivation and removal from the permit in the future. CSO 211 was being evaluated for deactivation but is likely to remain in the permit until the CSO 212 Sewer Separation project is complete. Three additional outfalls, CSOs 103, 208, and 211, are currently being evaluated and the City anticipates permanent deactivation and removal from the permit in the future. One additional outfall (CSO 117) will be permanently deactivated and removed from the permit. This deactivation is anticipated before the next permit is issued in October 2021. Thus, there are currently 25 active CSO locations remaining. See Figure ES-1 for the Omaha and CSS service area overview.

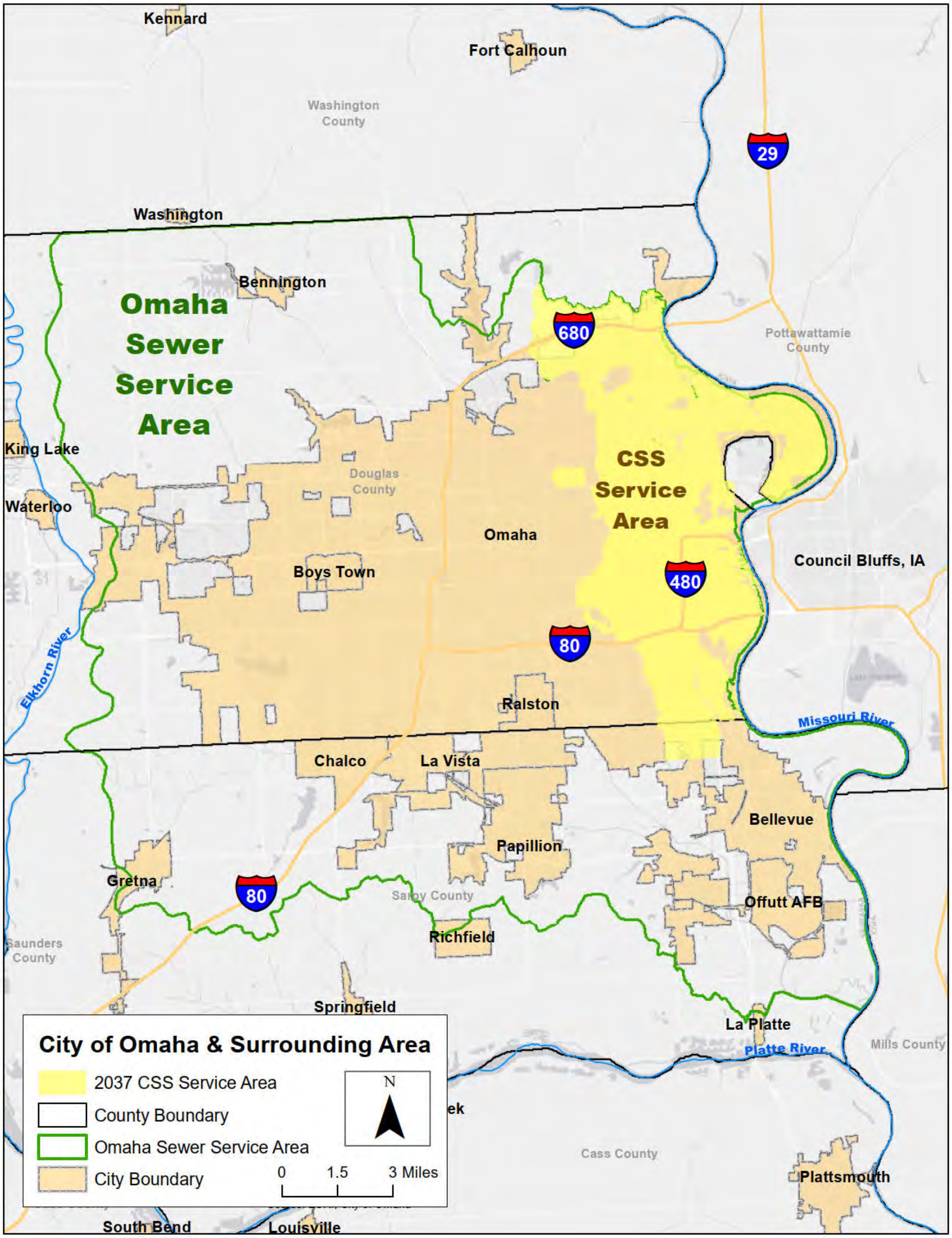

FIGURE ES-1
City of Omaha and Surrounding Area

In the last 15 years of LTCP implementation, the following challenges have been encountered and dealt with:

- Flood events
- Construction bids over the budget
- South Interceptor Force Main (SIFM) project delays
- Price increases for goods and services
- Utility coordination resulting in delays in construction
- COVID-19 pandemic

This update has been structured slightly differently than the previous LTCPs. This includes organizing the discussion by the CSO outfalls rather than the watersheds and relying on attached memorandums to provide details rather than including detailed explanations in the LTCP body.

ES.2 Current Status of the Program

The City has made significant progress in the implementation of the LTCP under the CSO Program (Program) since 2009. Through February 2021, the City has paid $758 million to implement the LTCP. Approximately $477 million of this amount has been for construction. The City has awarded, or is currently bidding, more than $598 million in construction contracts, and nearly 90 percent of that contracted amount has been successfully won by local Omaha general contractors. Another $131 million in construction value is currently under design.. More than 26 of the 59 projects in the 2014 Long Term Control Plan (LTCP) Update have been completed, with another 13 that will be completed during the next permit term (2021 through 2026), including the system reliability projects.

With the implementation of projects, the City has made significant progress in reducing the impact of CSOs on the receiving waters. Accomplishments include the following:

1. Achieving 56 percent volume capture in the Missouri River Watershed (MRW) and 84 percent volume capture in the Papillion Creek Watershed (PCW) as of the end of 2019. All sewer separation projects in the MRW, except for Hickory and Pierce, are either in design or construction as of March 2021.
2. The CSO projects have met all compliance dates in the CSO Permit.
3. The construction of several green infrastructure projects that have provided some level of CSO control, reduced costs, and resulted in public amenities. Examples of this include Fontenelle Park Lagoon, Adams Park Wetlands, and re-establishment of the lake in Spring Lake Park.
4. Existing CSOs have been more accurately modeled because of the expansion and continuous updating of the InfoWorks ICM model. This has allowed the City to better understand the system and impacts of changes. In addition, the development of a water quality model allows the City to better understand the impacts on the receiving streams from the CSOs.

5. Sensitive Areas, including the list of threatened and endangered species, have been updated; the result was that there were no changes to the sensitive areas and minor modifications to the species of concern.

Section 2 summarizes projects in both the MRW and PCW that have been completed as of March 2021 or are under construction or design. It also provides overviews of the City's collection system model, and water quality model development. A discussion of significant challenges that have been encountered while implementing the LTCP is also provided.

ES.3 Evaluation of Alternatives

Section 3 provides a summary of evaluations of CSO controls that were conducted for the Missouri River and Papillion Creek Watersheds as part of the development of the 2021 LTCP Update. In addition to meeting regulatory requirements and obtaining community acceptance, one of the key goals of the CSO Program is to minimize cost impacts to ratepayers. This is a primary focus of the CSO Program Adaptive Management Process – to continually evaluate existing plans, identify new potential controls, and determine the most cost effective way to achieve water quality objectives. Since starting the development of the original LTCP in 2006, the City has learned more about its system, and has developed better tools such as an updated and expanded collection system model and a water quality model, which assist in evaluation of various alternatives. In addition, through the completion of 26 projects, lessons have been learned on how best to implement projects and evaluate them. This section discusses the evaluations that were performed since the 2014 LTCP Update.

In 2016, CSO Program costs were increasing and the City sought reductions in total costs. An evaluation called the Technical Assessment for Cost Savings (TACS) was conducted to evaluate cost effective alternatives to planned projects. Approximately 2 dozen alternatives were evaluated, and results suggested that significant cost savings were possible. All the alternatives included a Deep Tunnel System (DTS) similar to that already in the LTCP. The City also wanted to evaluate whether any alternatives without tunnels would be able to achieve the required level of CSO control, and whether further cost savings were possible. As a result, an Optimization Evaluation was conducted to evaluate the alternatives more thoroughly.

The Optimization Evaluation focused on reviewing CSO controls in the MRW, where it is estimated that the completion of the projects currently under design or construction will result in the MRW reaching approximately 70 percent wet weather volume capture. The Optimization Evaluation analyzed alternatives for going from 70 to 85 percent wet weather volume capture in the MRW. A broad range of technologies was considered, including alternatives with and without tunnels. The Optimization Evaluation consisted of the following phases of work that are illustrated on Figure ES-2:

- Optimization Analysis
- Vetting of High-Performing Alternatives
- Concept and Cost Verification

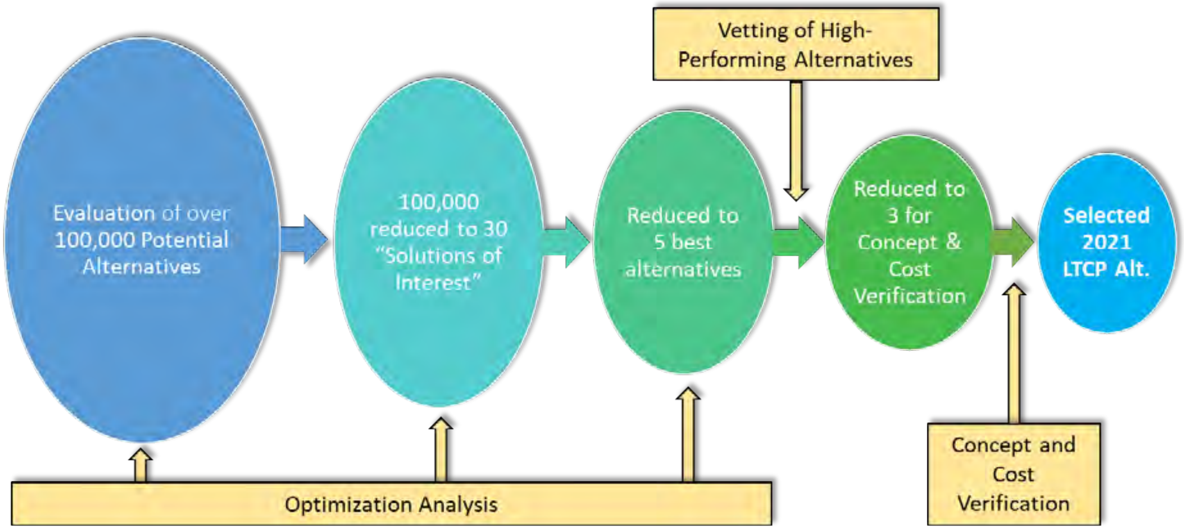

FIGURE ES-2
Optimization Evaluation Flowchart

The Optimization Analysis evaluated more than 100,000 potential alternatives comprised of individual elements called alternative components. Each component was a specific control such as a storage tank, retention treatment basis (RTB), or actively controlled gate. Each alternative's performance in terms of wet weather volume capture and lifecycle cost were determined, and all alternatives were compared using plots that identified cost effective solutions at any given level of CSO control. The Optimization Analysis went through several cycles of evaluation to reduce the list of potential alternatives to about 30 "Solutions of Interest" (SOIs) for further scrutiny, which was then reduced to the 5 best alternatives called "High-Performing Alternatives" (HPAs).

Because the Optimization Analysis evaluated a very large number of alternatives, some simplifications were necessary in the process. Some alternative components were modeled with simplified approaches, and only a portion of the representative year rainfall was evaluated to reduce model runtimes. Therefore, the Vetting of High-Performing Alternatives effort was conducted to make any necessary adjustments and confirm that the five HPAs could achieve 85 percent wet weather volume capture using the full representative year rainfall. This effort reduced the five HPAs to two HPAs for Concept and Cost Verification, and a third HPA was added that combined desirable elements from the two HPAs.

The Concept and Cost Verification refined the concepts in the three HPAs to develop more accurate, site-specific, planning-level costs than had been used during the Optimization Analysis. This effort developed comparative-level concepts among the three HPAs and comprehensive cost estimates that provided information the City needed to determine a path forward for the 2021 LTCP Update.

The City decided to proceed with a solution referred to as "NTS.R3.2" that includes an RTB, a storage tank, several active control facilities, and conveyance to increase the flows that can be treated at the RTB. This HPA had lower capital costs for CSO control than the other HPAs and operations and maintenance requirements similar to other facilities owned and operated by the City, such as the CSO 102 disinfection facility and the Saddle Creek RTB (SCRTB; currently in construction).

During the Optimization Evaluation, the Forest Lawn Creek Inflow Removal and Outfall Storm Sewer was re-evaluated, and a decision was made to move forward with the project. The project is currently under redesign and construction should begin by 2022.

Additionally, it was determined that prior to the start of the Hickory Street and Pierce Street Sewer Separation projects, a further evaluation is needed. These projects have been found to be unnecessary to achieve 85 percent wet weather volume capture. This evaluation will be focused on determining if flows from these areas into the Leavenworth Lift Station need to be reduced and the best way to do so. This will occur over the next 5 years with a project being proposed if needed in the 2026 LTCP Update.

For the PCW, the majority of the CSO projects are under design or construction. However, there were a few CSO outfalls where the City performed an evaluation to determine the best path to move forward. This included the following:

- CSO 201 – As part of the Water Resource Recovery Facilities (WRRFs) Master Plan project, an evaluation was performed to determine what, if any, additional controls were needed to address CSO 201. The result of the evaluation was to recommend increasing the peak hydraulic capacity of preliminary and primary treatment at the Papillion Creek WRRF (PCWRRF) to 190 million gallons per day (MGD). The need and timing for accommodating any peak flows higher than this is dependent on the outcome of the City's efforts to reduce infiltration/inflow (I/I) in the PCWRRF service area.
- CSO 204 – The City performed an evaluation of various approaches to address cost and risk concerns associated with CSO 204 Phase 2 Sewer Separation Project. As a result, the City developed a concept for an alternative approach that consists of the construction of the 61st and Radial Storm Sewer, which will pull some of the stormwater off the CSS and divert it to Cole Creek.
- Cole Creek Interceptor – one of the outcomes of the evaluation of the CSO 204 area was the development of projects to rehabilitate the east and west branches of the Cole Creek Interceptor. Because the east branch has the potential to impact the ability to deactivate CSOs 202 and 203, the rehabilitation of the east interceptor will be included in the LTCP. Rehabilitation of the west branch will be funded outside of the CSO Program.
- CSO Diversions – This original project was in the 2009 LTCP to address the closing of the Cole Creek CSO diversions. It has been modified to a program to include all the Papillion Creek CSO outfalls that have not yet been closed but are intended for closure, as well as CSOs 103 and 112 in the MRW. This will allow for the deactivation of the diversions after monitoring and any needed inflow reduction.
- CSO 211 Inflow Reduction, CSO 210 Inflow Reduction, and CSO 204 Phase 5 – The City has determined that these projects should no longer be included in the LTCP. They were placeholder projects, and the City has instead included them as part of an Inflow and Infiltration Reduction Program.

Both the Missouri River and Papillion Creek Watershed revised projects are defined in Section 5.

ES.4 Program Financing and Financial Considerations

The purpose of Section 4 is to meet the requirements of Part V.E. Cost/Performance Considerations of the City's CSO Permit. The CSO Permit requires (NDEQ, 2015):

> "The City of Omaha shall submit a financial report to the NDEE by March 31, 2021; that sets forth a strategy to obtain sufficient revenue to fund the CSO Program through at least the year 2024 that includes funding for the specific projects in the Implementation Schedule, Section 7 of the LTCP (see also Update to 2014 LTCP)."

As noted in the 2009 LTCP and 2014 LTCP Update, the implementation of the LTCP will be dynamic in nature and, therefore, there are uncertainties in Program costs, funding, and financing. While Omaha's user fees have met revenue requirements through the last two NPDES permit cycles, and Omaha's financial plan and cost-of-service rate model have been updated to extend throughout the LTCP schedule ending in 2037, financial uncertainties beyond Omaha's control remain a concern and will be managed adaptively.

The current escalated cost of the Program with contingencies is approximately $2 billion through 2037, as explained in Section 5.4 of this 2021 LTCP. Rates are currently in place for 2019 to 2023 based on the most recent Rate Ordinance as approved by the City. As part of the TACS evaluation, along with the Program Optimization Evaluation that was discussed in Section 3 of this document, an overall potential savings of more than $500 million has been achieved in comparison to the highest estimated cost of the Program, which occurred in 2016, prior to the initiation of the cost savings measures.

The extension provided in 2018 to the LTCP schedule helped with lowering the rate burden of the Program, as did significant reductions in the cost of the Program. Other factors such as reduction in financing costs have also been very beneficial.

The 2021 LTCP Update meets the EPA affordability criteria as they exist now, but they do not adequately account for community-specific impacts of the sewer rates. However, EPA has recently finalized modifications to the criteria, which allow for incorporation of community-based criteria.

The City will continue to seek grants and loans to reduce the cost of the Program to the ratepayers.

ES.5 Updated CSO Controls

Section 5 describes the updated controls included in this 2021 LTCP Update to improve water quality in the Missouri River and Papillion Creek Watersheds.

This section includes a list of controls for each watershed and identifies controls that have changed compared with what was planned in the 2009 LTCP and 2014 LTCP Update. It provides a discussion of the expected wet weather volume capture and water quality improvements after full implementation of the controls. This 2021 LTCP Update incorporates the results of the alternatives evaluation described in Section 3, Evaluation of Alternatives. The operational strategies for the controls discussed in this section are included in the updated Section 8, Post Construction Monitoring Plan and Section 9, Wet Weather Operations Plan.

Section 5.3 provides a comparison of the 2009 LTCP controls, 2014 LTCP Update controls, and those proposed in this 2021 LTCP Update. See Figure ES-3 for LTCP controls. It shows that the changes comply with the CSO Permit, Consent Order, and the EPA CSO Control Policy. As noted, because of the Optimization Evaluation there are significant changes in the controls for the MRW. The changes in the PCW are less significant and are focused on CSO 204 and a reduction in the size of the SCRTB.

Tables 5-1 through 5-4 provide summaries of the projects that have been completed, removed, or added to the LTCP, respectively. The following is a list of the projects that have been removed:

- CSO Deep Tunnel
- CSO Tunnel Lift Station and Force Main
- RTB at Missouri River Water Resource Recovery Facility (MRWRRF)
- RTB Dewatering Lift Station
- Bridge Street Lift Station and Force Main
- CSO 204 Storage Tank
- CSO 204 Phase 2
- CSO 204 Phase 5
- CSO 210 Inflow Reduction
- CSO 211 Inflow Reduction
- Nicholas and Webster Separation Phase 2

The following are new projects that have been added:

- East Cole Creek Interceptor Rehabilitation
- 61st and Radial Storm Sewer
- Minne Lusa Relief Sewer Diversion Modifications
- Grace St and North Interceptor DWF Diversion Rehabilitation
- CSO 105 Outfall Active Control
- North Downtown Conveyance Sewer - 11th and Izard to 6th and Abbott
- 11th and Izard Grit and Screening Facility
- 11th and Izard Active Control
- Northeast Omaha RTB - 6th Street and Abbott Drive
- 21st and Cuming Active Control
- Leavenworth Basin Storage Tank (CSO 109)

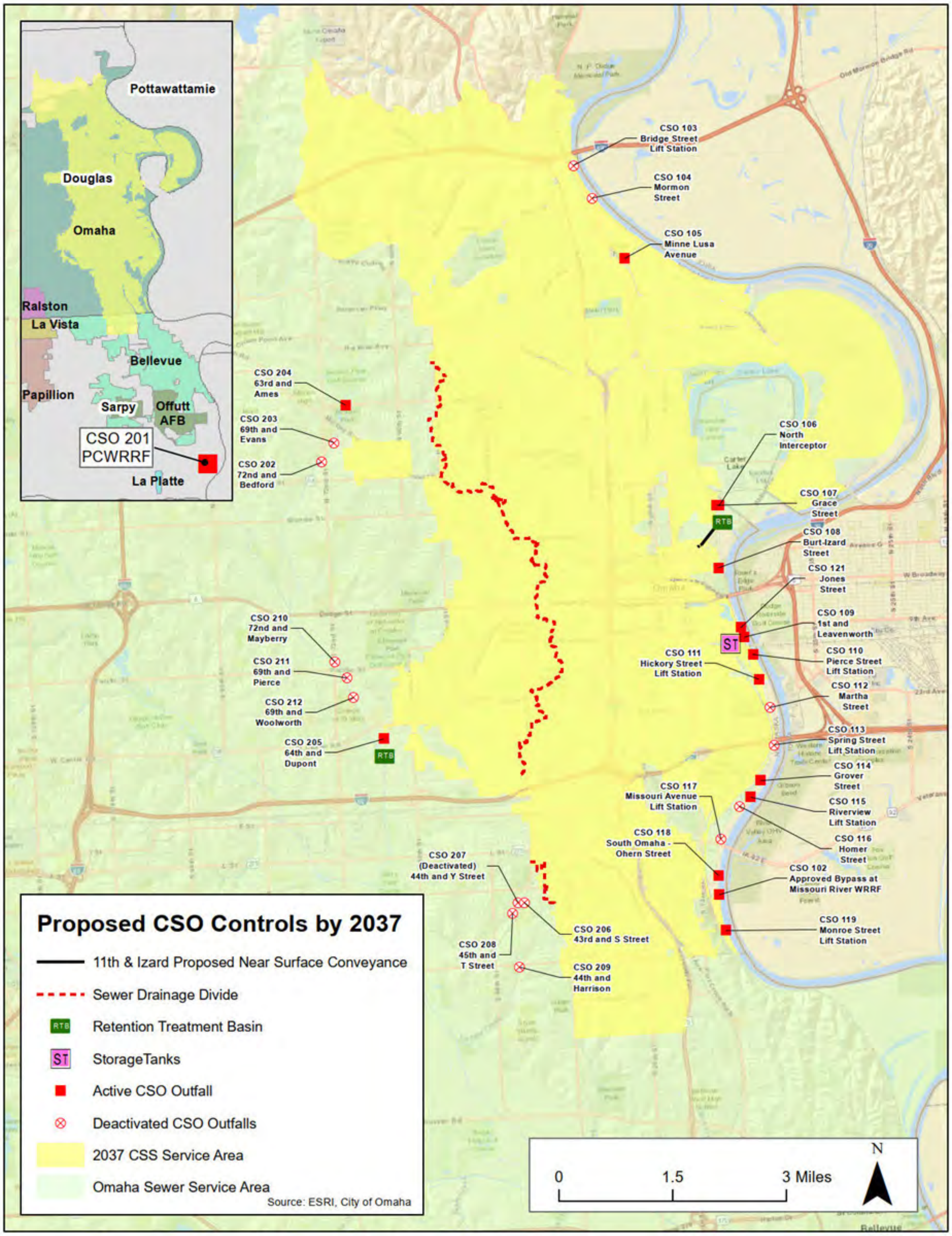

FIGURE ES-3
Proposed CSO Controls by 2037

In addition, the City is establishing an I/I Reduction Program that will address wet weather impacts after completion of sewer separation. This potentially could include inflow reduction in the CSO basins serving CSO 202, CSO 203, CSO 204, CSO 208, CSO 210, CSO 211, CSO 212, and potentially other CSO basins in the MRW. It is not anticipated that inflow reduction will be necessary in all CSO basins. The goal of the program will be to achieve the anticipated CSO deactivation committed to in the 2021 LTCP Update.

The City will continue to implement and define its Green Infrastructure Program. As before, green infrastructure will not be a fundamental element of the City's approach to achieve 85 percent capture; however, it can potentially provide some amount of additional wet weather volume capture, water quality benefits, and improve local stormwater management issues. As demonstrated in the past, green infrastructure can also save costs by reducing the extent or sizing of gray infrastructure. The City's Green Infrastructure Program includes projects and initiatives such as the following:

- Maximize the use of existing green infrastructure through real-time controls (RTCs).
- Development/Private Opportunities: The City will continue to look for partnering, incentive, and funding opportunities, and implementing different design requirements to reduce CSOs when development opportunities arise. To prioritize CSS areas that could have the largest impact on the CSO Program, an evaluation was performed to determine what CSO areas would have the best potential for green infrastructure or inflow reduction based on overflow reduction effectiveness (ORE). OREs predict how much CSO will be reduced with a given reduction in runoff. As such, they can be used to prioritize green infrastructure projects.
- Incentive Program: It is currently the City's plan to evaluate the possibility of developing an incentive program for implementation of green infrastructure on private property.
- City Programs: City programs or initiatives will be explored that could promote or require implementation of green infrastructure as part of City projects and operation.

As a result of the modifications noted above, there has been a reduction in the total estimated cost of the program. The revised cost of the Program is $1,998,952,000, or approximately $2 billion as explained in Section 5.4 of this 2021 LTCP. When the total capital costs for the 2009 LTCP, 2014 LTCP Update, and 2021 LTCP Update are expressed at the same cost basis, they show that the total estimated cost in the 2021 LTCP Update has been reduced from the 2009 LTCP and 2014 LTCP Update.

Compliance with the 85 percent wet weather volume capture criterion is discussed through results of the collection system modeling and water quality modeling. The CSO controls were modeled to ensure that they will achieve the 85 percent wet weather volume capture requirement. Figures ES-4 and ES-5 provide graphical representations of the CSO volumes in the Missouri River and Papillion Creek Watersheds, respectively. The figures primarily illustrate the CSO volumes, but the volumes treated by the two RTBs and the MRWRRF Chlorine Contact Basin are also shown. The wet weather volume capture of the MRW will be 85 percent during the representative year once all controls are completed. For the PCW, the representative year wet weather volume capture will be 97 percent.

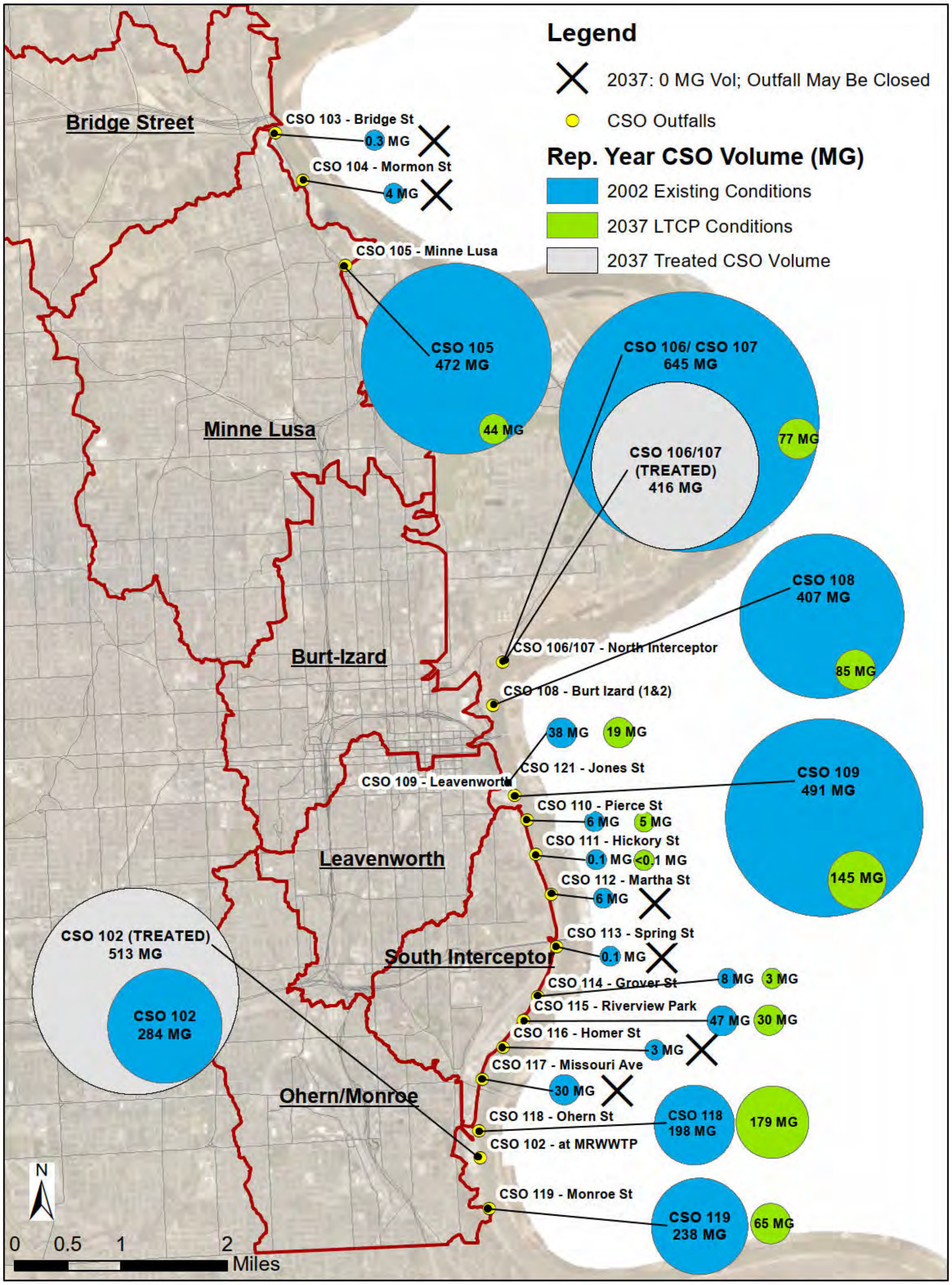

FIGURE ES-4
Graphical Representation of CSO Overflow Volumes in 2002 Compared to 2037 for the Missouri River Watershed

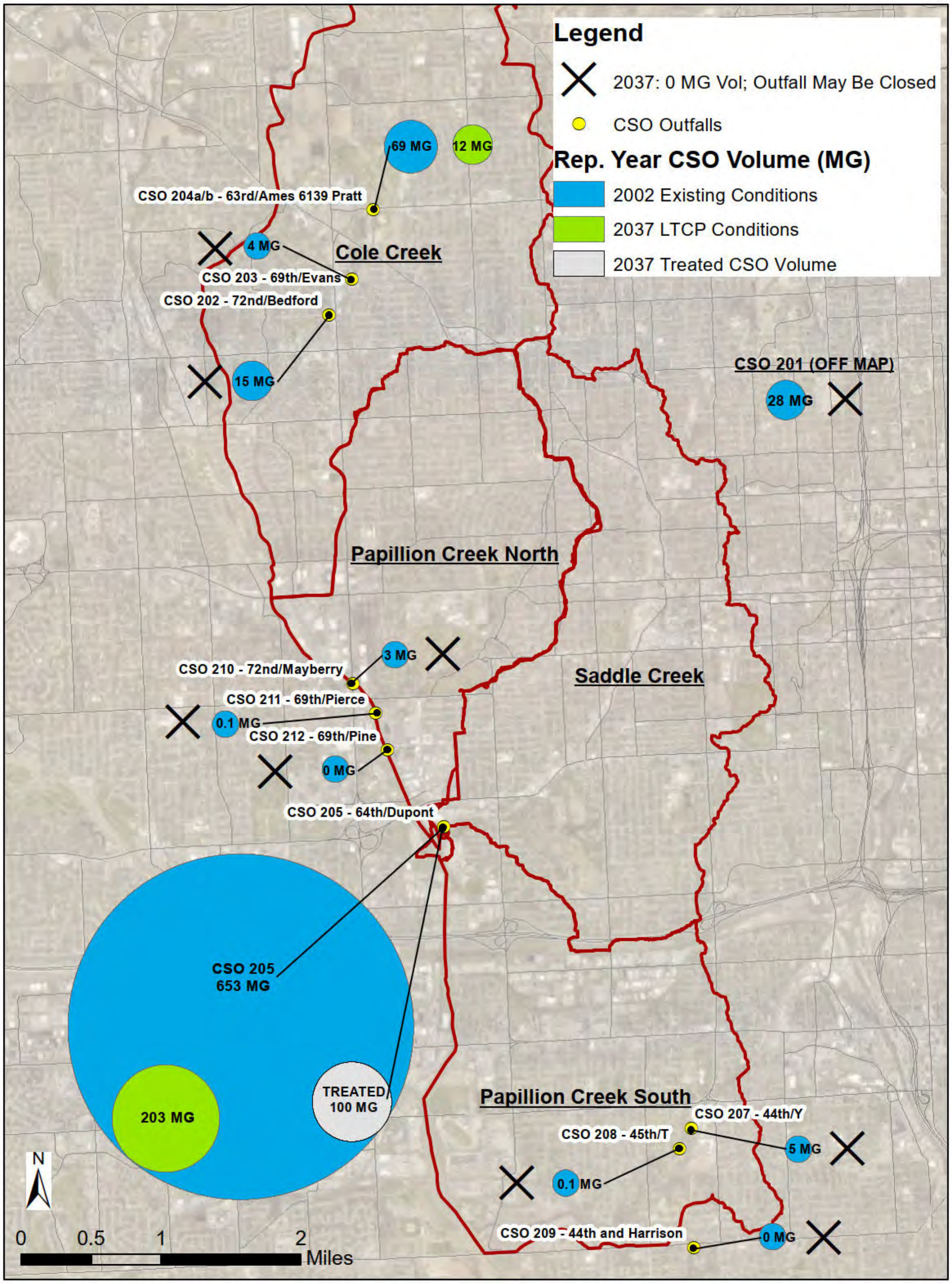

FIGURE ES-5
Graphical Representation of CSO Overflow Volumes in 2002 Compared to 2037 in the Papillion Creek Watershed

An important element of the development of the 2021 LTCP Update was to evaluate the impact of the proposed controls on the receiving water quality of the Missouri River, Papillion Creek, and tributaries. The purpose of the water quality evaluation was to provide confidence regarding the presumption of meeting the water quality standard or not precluding the standard from being achieved. The primary focus of this evaluation was *E. coli* because this is the pollutant of concern for CSOs identified by NDEE. The model development is summarized in Section 2 and in Appendix C.

The Missouri River Water Quality Model shows that water quality standards for *E. coli* can be attained in the Missouri River.

The Papillion Creek Water Quality Model shows that, while Papillion Creek and its tributaries are not expected to achieve attainment of water quality standards upon completion of the implementation of the LTCP, it can be presumed that achievement of the *E. coli* standard will not be precluded by the remaining CSOs.

ES.6 LTCP Schedule

Section 6 includes a revised LTCP schedule and describes significant scheduling assumptions. The 2021 LTCP schedule was developed in conjunction with schedules being developed for modifications to the City's WRRFs and investments in the collection system. Unlike the previous LTCP documents, the schedule being proposed does not include phases for projects nor does the schedule categorize projects as "Major Projects" or "Sewer Separation Projects."

The LTCP schedule was developed in an integrated manner incorporating other City infrastructure needs for the treatment system and collection system. This has allowed the City to address other regulatory requirements and infrastructure needs while continuing to implement the LTCP.

The approach to the 2021 LTCP schedule has changed from 2009 LTCP and 2014 LTCP. These LTCPs included schedules with seven phases of sewer separation and four phases of Major Projects. This has worked well and provided the City with flexibility. However, because of the progress the City has made, the 2021 LTCP Update includes only 29 projects, including 4 that are system reliability projects that do not have specific schedules. Of these projects, 13 are anticipated to be complete during the 2021 to 2026 CSO Permit term, 7 of which are under construction or will be by October 1, 2021. The City has structured the schedule be based on only the construction completion dates (substantially complete for sewer separation projects and operationally complete for facility projects). Table ES-1 provides a graphical representation of the LTCP schedule, with years of completion shown in color for each project.

The ability to meet the LTCP schedule is based on various factors as noted in Section 6.4. The City will continue to work with the NDEE regarding any unforeseen circumstances that occur over the course of implementation.

TABLE ES-1
2021 LTCP Update Project Schedule

		October 1, 2021 to September 30, 2026					**October 1, 2026 to September 30, 2031**					**October 1, 2031 to September, 2036**					
Project Name	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**
Cole Creek CSO 204 Area - Phase 3 Combined Sewer Separation (Taylor to Ruggles Between 56th and 61st)																	
Papillion Creek North (PCN) 210 Sewer Separation																	
Cole Creek CSO 203 Sewer Separation Project (CSO)																	
Saddle Creek Retention Treatment Basin																	
Forest Lawn Creek Inflow Removal and Outfall Storm Sewer																	
CSO 212 - 64th Avenue and William Street																	
Nicholas Street Sewer Extension - Phase 3B																	
East Cole Creek Interceptor Rehabilitation																	
CSO 119 South Barrel Conversion and Sewer Separation																	
CSO 202 Phase 2 - 70th Avenue and Spencer Street																	
Minne Lusa Relief Sewer Diversion Modifications																	
61st and Radial Storm Sewer																	
Grace St and North Interceptor DWF Diversion Rehabilitation																	
CSO 105 Outfall Active Control																	
CSO 204 Phase 4a - 57th Street and Pratt Street																	

TABLE ES-1
2021 LTCP Update Project Schedule

		October 1, 2021 to September 30, 2026					October 1, 2026 to September 30, 2031					October 1, 2031 to September, 2036					
Project Name	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**
North Downtown Conveyance Sewer - 11th and Izard to 6th and Abbott																	
CSO 204 Phase 4b - 56th Street and Bedford Avenue																	
11th and Izard Grit and Screening Facility																	
11th and Izard Active Control																	
Northeast Omaha RTB - 6th Street and Abbott Drive																	
Jones Street to Leavenworth Diversion																	
21st and Cuming Active Control																	
Hickory Street Sewer Separation																	
Pierce Street Sewer Separation																	
Leavenworth Basin Storage Tank (CSO 109)																	

ES.7 Public Involvement

The City is committed to an active Public Participation Program. Over the timeframe of the Program, outreach efforts have expanded and evolved to meet the needs of the community. The multifaceted approach to public outreach and the sophistication of its implementation have been recognized by professional organizations, acknowledged by third parties, and continue to be innovative.

Public education efforts target ratepayers, industrial users of the system, and residents who live within the designated improvement areas. Since the CSO Program began in 2006, the Program has provided education and facilitated input on the progress of the LTCP. More than 15 years later, the City continues to meet with area residents, attend neighborhood and business organization meetings, and keep regular contact with industrial users.

Each category of stakeholders is considered and engaged appropriately in the public participation planning: residential ratepayers, business and industry, general contractors and small and emerging small business contractors, elected officials, youth, and many others.

As described in Section 2 of this LTCP Update, the Program has adapted to intervening factors including 2 years of major flooding, the need to slow ratepayer cost increases, and the need to assess project effectiveness before embarking on new projects; all of which have resulted in a 13-year extension to the Program from the original end date in 2024 to the current one in 2037. The impact of the extension on public participation is two-fold: 1) it challenges the Program's ability to hold the interest of the public, and 2) the project work is now spread out over an additional 13 years, which extends the disruption caused by construction and the need for patience from the public.

As a result, public outreach strategies and tactics have adapted too. The high-touch strategies from 2015 to 2019, which included in-person presentations, meetings with business organizations, and interaction with classrooms and events, were halted in early 2020 due to the pandemic. Even while engaging in high-touch activities, the public participation team had built a foundation of online resources and enhanced an already established website presence allowing public education and outreach to continue.

The public participation approach for the LTCP includes:

- Public meeting(s)
- Stakeholder meetings with elected officials and industrial ratepayers
- Video presentations to reflect goals of capture, fulfilling the Consent order, highlighting major changes, and the path forward
- Program public website feature on the home page with a video presentation and resource information
- Blog posts leading up to the release that feature success stories of the Program
- Blog post after the LTCP Update is introduced to explain highlights by experts
- Increased social media postings to drive the stakeholders to website information
- Media briefings for news coverage and interview opportunities

Over the next 5 years, the strategies will embrace new technology, expand social media, build community relationships, and provide the information and outreach to be successful. On a monthly basis, the City tracks and reports the progress of engagement through both third-party sources and data gathering. The City will continue to work toward and advance the goal of community acceptance.

ES.8 Post Construction Monitoring Plan

The City has developed a Post Construction Monitoring Plan (PCMP) that will measure compliance with the requirement to show that CSO controls achieve 85 percent wet weather volume capture on an annual average basis at the end of the Program, and to show trends in water quality that could be related to the CSOs and implementation of the LTCP. This will be done with collection of water quality data on the Missouri River by the United States Geological Survey (USGS) and in the Papillion Creek Basin by the City, along with flow monitoring. In general, flow monitoring of the effectiveness of sewer separation will be performed by the City. Individual monitoring plans will be developed by project teams for wet weather facilities, as the facilities typically include permanent monitoring equipment. Using the data validation methods in the plan discussed in Section 8 and Appendix A, the City will be able to confirm achievement of this goal and sufficiently demonstrate it to EPA and NDEE.

ES.9 Wet Weather Operations Plan

The original Wet Weather Operations Plan (WWOP) was submitted with the 2009 LTCP. The 2021 LTCP Plan updates this plan to reflect the changes in the CSO controls as proposed in this 2021 LTCP Update. The WWOP in Section 9 and Appendix B present a general overview of the control facilities, and how the City anticipates the control facilities' operation will be coordinated. It also provides general procedures, operation and staffing guidelines for the CSS during wet weather events based on the constructed controls, proposed controls in the LTCP, and general assumptions. It is anticipated that the procedures and staffing will be refined throughout the design of the individual facilities and during implementation of the Program.

The new and existing facilities included in the plan are MRWRRF, PCWRRF, SCRTB, Northeast Omaha RTB, and Leavenworth Basin Storage Tank as well as the various active controls. The WWOP covers pre-event, during-event, and post-event operations for each of the facilities. The plan also includes operations for the various lift stations within the collection system.

This plan will need to be updated as the controls are updated. Throughout the implementation of the LTCP, the City will continue to evaluate methods to maximize use of the existing collection system. This involves evaluating the implementation of RTC and active controls to maximize flow to both the WRRFs. Implementation of RTC will likely result in changes to the WWOP.

1 Introduction

1.1 Overview of the 2021 Long Term Control Plan Update

The 2021 LTCP Update to the City of Omaha's (City) Long Term Control Plan (LTCP) is in compliance with the City's combined sewer overflow (CSO) Permit (National Pollutant Discharge Elimination System [NPDES] Permit No. NE0133680; NDEQ, 2015) and Complaint and Compliance Order by Consent (Consent Order) which was last modified on October 16, 2019. The City's current CSO Permit and the Consent Order require an updated LTCP be submitted by March 31, 2021.

This is the second update to the 2009 LTCP (City of Omaha, 2009), which was submitted to the Nebraska Department of Environment and Energy (NDEE)[1] in September 2009 and approved February 2010. Implementation of the CSO controls in the 2009 LTCP started in the summer of 2009 and is continuing. Subsequently, on September 29, 2014, an update to the 2009 LTCP was submitted to NDEE and approved on January 23, 2015. That update is referred to as the 2014 LTCP Update (City of Omaha, 2014). The 2014 LTCP Update has been modified several times over the last 5 years. Table 1-1 provides a summary of those modifications.

[1] Formerly the Nebraska Department of Environmental Quality (NDEQ)

TABLE 1-1
Summary of 2014 LTCP Update Modifications

Date of Request	Date Approved	Summary of changes
March 24, 2015	April 3, 2015	Requested changes were: Combine the Minne Lusa Stormwater Conveyance Project and Stormwater Detention Basin Improvements projects into one project. Combine various projects in the Minne Lusa Basin into a single project titled Lake James to Fontenelle Park. Combine the 16th and Grant project with the Nicholas Phase 3 project. Rename the tanks at CSOs 118 and 119 to the Ohern Basin Storage Facility and Monroe Basin Storage Facility.
August 17, 2015	August 20, 2015	Requested extension on Major Projects Phase 2, Complete Construction, from December 31, 2018 to September 30, 2020.
March 1, 2017	July 19, 2017	Requested changes were: Change South Interceptor Force Main (SIFM) Project Completion date from June 30, 2017 to June 30, 2018. Change Major Projects Phase 2, Complete Construction, from September 30, 2020 to December 31, 2023. Remove Major Projects Phase 3 and associated projects in the Minne Lusa Basin.
March 28, 2019	May 20, 2019	Requested changes were: Modify the LTCP Update submission date from October 1, 2019 to March 1, 2020. Change the Major Projects Phase 4, Start Final Design, from December 31, 2019 to December 31, 2023. Change Sewer Separation Phase 5, Commence Bidding, from June 30, 2020 to December 31, 2021.
June 5, 2019	July 9, 2019	Request to modify LTCP Update submission date from March 1, 2020 to March 31, 2021.

Since the start of implementation of the LTCP in June 2009, the City has been following an adaptive management approach. This approach ensures that controls are implemented in a manner that minimizes ratepayer impacts while accomplishing the goals of the LTCP. This document (2021 LTCP Update) describes the update process, presents new evaluations that have been conducted, summarizes the outcome of the evaluation effort, and recommends improvements in the CSO controls as an outcome of the City's adaptive management approach. It also provides information on the status of LTCP implementation. Since the 2021 LTCP Update builds upon the 2009 LTCP and 2014 LTCP Update rather than replacing them, the previous LTCPs should be consulted for additional information.

The document follows the format of the 2009 LTCP and the 2014 LTCP Update and is not a standalone document. In addition to Section 1 – Introduction, this document includes the following sections:

- **Section 2 – Current Status of the Program.** Provides a summary for each CSO outfall of the current projects being implemented or those which have been completed. In addition, a summary of the changes to the hydraulic model used to estimate CSO discharges and the development of a new Water Quality Model for the Missouri River are discussed.
- **Section 3 – Evaluation of Alternatives.** Describes new evaluations performed for this 2021 LTCP Update related to the selected control technologies for CSO outfalls. This includes a discussion of the Optimization Evaluation performed for the Missouri River Watershed along with other evaluations.
- **Section 4 – Program Financing and Financial Considerations.** Provides the City's current plan for financing LTCP implementation through 2037 with emphasis on the next permit term of 2021 to 2026.
- **Section 5 – Updated CSO Controls.** Describes the controls associated with each CSO outfall and basin that are being committed to in this LTCP Update. This section also shows that the controls to be implemented comply with United States Environmental Protection Agency (EPA) CSO Control Policy requirements and includes a discussion on the water quality benefits from the controls.
- **Section 6 – LTCP Schedule.** This section presents the LTCP schedule with proposed compliance dates and summarizes the development of the schedule.
- **Section 7 – Public Involvement.** Summarizes the City's efforts to inform the public in the decisions made following approval of the 2014 LTCP Update and describes anticipated future efforts by the City on continued public involvement.
- **Section 8 – Post-Construction Monitoring Plan.** Summarizes the changes to the Post Construction Monitoring Plan from that included in the 2009 LTCP. An updated plan is included in Appendix A of this LTCP Update.
- **Section 9 – Wet Weather Operations.** This section summarizes the modifications made to the Wet Weather Operations Plan. An updated plan is included in Appendix B.

The following Appendixes are also included with this 2021 LTCP Update:

Appendix A – Post Construction Monitoring Plan

Appendix B – Wet Weather Operations Plan

Appendix C – Water Quality Model Technical Memorandum

Appendix D – Agency Letters. Letters to and from Governmental Agencies regarding Endangered Species and Drinking Water Intakes for Determination of Sensitive Areas

Appendix E – Optimization of CSO Controls Report

Appendix F – Vetting of High Performing Alternatives Technical Memorandum

Appendix G – High Performing Alternative Concept and Cost Verification Technical Memorandum

Appendix H – City of Omaha Sanitary Sewerage Revenue Refunding Bonds Documentation

1.2 Regulatory Requirements

CSOs are regulated under the Clean Water Act (CWA) through the NPDES program, which permits and regulates wastewater discharges. The NDEE has been delegated the authority for Nebraska's NPDES program by EPA. The City developed the 2021 LTCP Update in compliance with requirements of the EPA "CSO Control Policy" (59 Federal Register 18688); the August 8, 2007, Complaint and Compliance Order by Consent (as amended in 2012, 2018, and 2019; Consent Order); and the City's NPDES permits for the combined system (CSO Permits) as discussed in the following sections of this document.

1.2.1 EPA CSO Control Policy

In April 1994, EPA published a CSO Control Policy (59 Federal Register 18688) to explain how communities and states could control CSOs while meeting CWA requirements and to provide a process for addressing CSOs. The first step in the process is the development and implementation of a Nine Minimum Controls (NMC) Plan, which includes controls or measures that can reduce CSOs without significant engineering study or major construction. This step has been completed by the City, and the processes in the NMC Plan continue to be followed (City of Omaha, 2007) and reported in the City's Annual Report on LTCP implementation.

The CSO Control Policy requires the development of a LTCP using either the Demonstration Approach or the Presumption Approach to achieve compliance (EPA, 1995a). Under the EPA Presumption Approach to compliance, the EPA CSO Control Policy calls for either the capture of at least 85 percent by volume of the combined sewage entering the collection system during wet weather, or no more than four to six untreated overflows on a systemwide annual average basis.

The 2009 LTCP and subsequent updates were developed using the Presumption Approach.

1.2.2 Consent Order

On August 8, 2007, the NDEE finalized a Consent Order with the City of Omaha. It remained unchanged until 2012 when it was modified to address the 2011 Missouri River Flood (2011 Flood), which was considered a *force majeure* event under the Consent Order. This amendment added 3 years to the implementation schedule, resulting in a LTCP completion date of October 1, 2027.

On January 17, 2018, NDEE approved a 10-year extension to the Consent Order, resulting in a final completion date of October 1, 2037. The justification for the extension was based on the following:

- Uncertainty as to how component projects within the LTCP can be funded in the future
- Fluctuation in costs of the component projects
- Unknown physical conditions of soil in the areas where construction is expected to occur

- Unanticipated limitations in engineering or construction capacities in the area
- Changes in NPDES requirements and Nebraska Water Quality Standards

As part of the negotiation of the Consent Order, the City requested additional time, which has as follows:

- Provided the City with time to implement the projects
- Allowed the City to evaluate and optimize the operation of the CSO controls currently in place to determine their effectiveness
- Provided the City with time to evaluate the collection system and develop plans to optimize its operation
- Integrated both CSO and non-CSO project schedules so that costs and sewer rates are balanced
- Allowed for a more gradual increase in sewer rates

Language in the Consent Order was also modified to specifically state the requirement to achieve 85 percent wet weather volume capture. Paragraph 6 of the Consent Order states in part, “The City's CSO compliance objective is to eliminate or capture for treatment no less than 85% by volume of the combined sewage collected in the combined sewer system, during precipitation events on a system wide annual average basis. The success of the City's efforts to capture for treatment or elimination of 85% of the combined sewage will be determined after completion of the LTCP.”

The 2018 amendment also changed the date for submission of the LTCP Update from October 1, 2019 to March 1, 2020. It was again modified in October of 2019 to address the 2019 Flood, which was also a *force majeure* event. This amendment involved changing the date for the submission of this LTCP Update from March 1, 2020 to March 31, 2021. The basis of the request to change the LTCP submission date was the following:

- The City was very busy addressing flood-related tasks, including Federal Emergency Management Agency (FEMA) documentation, and did not have the time needed to fully participate in the development of the LTCP Update.
- Both the Papillion Creek Water Resource Recovery Facility (PCWRRF) and the Missouri River Water Resource Recovery Facility (MRWRRF) were highly impacted by the flood, and operational staff were not available to participate in discussions regarding the LTCP until the facilities were fully operational and reliable.
- The City continues to face a significant financial impact from the flood, and such constraints need to be reflected in the LTCP Update.
- There were concerns over the potential unavailability of bidders and the inability to obtain competitive bids for projects because of the amount of work resulting from the flood. The additional time allowed the City to reflect this in the schedule for projects in the LTCP Update.

This 2021 LTCP Update was developed to reflect these items listed above and includes a list of projects and programs that achieves the 85 percent volume capture and a schedule that incorporates this additional time to reflect the current completion date of October 1, 2037.

1.2.3 National Pollutant Discharge Elimination System Permit

The City has been operating under NPDES Permit No. NE0133680 issued on October 1, 2015, which authorizes the discharge from various CSO points within the City. The permit requires that prior to renewal of the permit certain submissions be made. The permit was due to expire on September 30, 2020 but has been administratively extended. An application for renewal was provided to the NDEE on March 28, 2020. The City has requested that the CSO Permit and the permits that cover their two Water Resource Recovery Facilities (WRRFs) be on the same schedule as the LTCP Update. This allows the permits to reflect the integrated operations that are necessary between the WRRFs and the LTCP controls being implemented, and to better reflect costs that are both flood and non-flood related.

The CSO Permit includes several requirements regarding the update to the LTCP. Table 1-2 summarizes the submissions that are addressed in this document and where they can be found. The 2021 LTCP Update is being submitted in compliance with these requirements and the Amended Consent Order.

TABLE 1-2
Comparison of CSO Permit Requirements and LTCP Update Sections

CSO Permit Requirement	LTCP Update Section	Comments
Part V.D. Evaluation of Alternatives - Any significant changes or revisions to the controls set forth in the LTCP and a final project list in the LTCP shall be submitted by March 31, 2021 to the NDEE for review and approval according to Part IX (F) *Revisions to the Long Term Control Plan.*	Section 3 – Evaluation of Control Alternatives Section 5 – CSO Controls Section 6 – LTCP Schedule	Section 3 provides a summary of the evaluations that were performed and their outcomes. Section 5 provides details on the chosen alternatives. Section 6 provides the LTCP schedule.
Part V.E. Cost/Performance Consideration - The City of Omaha shall submit a financial report to the NDEE by March 31, 2021; that sets forth a strategy to obtain sufficient revenue to fund the CSO Program through at least the year 2024 that includes funding for the specific projects in Section 7, Implementation Schedule, of the LTCP (see also 2014 LTCP Update).	Section 4 – Program Financing and Financial Considerations Section 6 – LTCP Schedule	Section 4 provides a summary of the financial plan. Section 6 provides the LTCP schedule.
Part IX. F. Revision of the Long Term Control Plan (LTCP) - The LTCP may require revision to reflect new information, new technology, or other changes that become evident during the LTCP implementation process. Proposed significant revisions to the LTCP shall be submitted by March 31, 2021, for review and approval by the NDEE. Significant revision to the LTCP generally means modification of the major CSO projects and milestone dates in Section 7, Implementation Schedule, of the LTCP.	Section 3 – Evaluation of Control Alternatives Section 4 – Program Financing and Financial Considerations Section 5 – CSO Controls Section 6 – LTCP Schedule	Section 3 provides a summary of the evaluations that were performed and their outcomes. Section 4 provides a summary of the financial plan. Section 5 provides details on the chosen alternatives. Section 6 provides the LTCP schedule.

1.2.4 Background

As noted in the 2009 LTCP, the Missouri River is the eastern boundary of the City, with Council Bluffs, Iowa, located across the river to the east, as shown on Figure 1-1. In Omaha's combined sewer system (CSS), gates or weirs divert the sanitary sewage during dry weather into interceptor sewers, which convey it to WRRFs. In dry weather, the amount of sewage flow is comparatively small and can be handled without overflows.

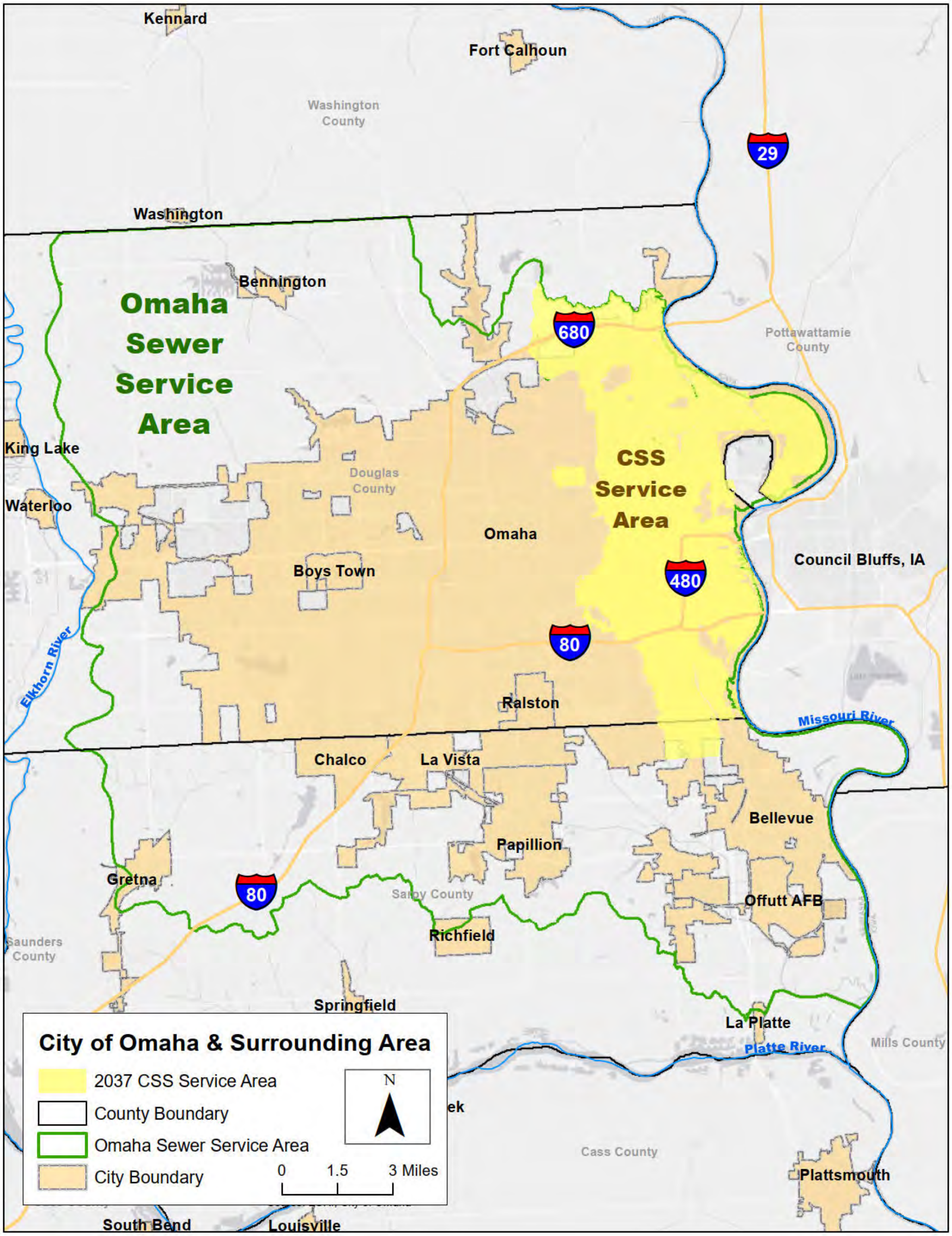

FIGURE 1-1
City of Omaha and Surrounding Area

During a wet weather event, stormwater and/or snowmelt is collected along with the sanitary sewage in the CSS and can significantly increase the flow rate. When the combined flow rate increases enough, the flow overtops a weir or passes through a gate and discharges into a river or stream at designed outfall points within the system. In 2009, 29 CSO outfalls were permitted by NDEE to discharge during wet weather from the City's CSS: 19 to the Missouri River and 10 to tributaries of Papillion Creek. Since that time, four of these outfalls (CSOs 104, 113, 207, and 209) have been deactivated or converted to stormwater only. CSO 207 remains in the current NPDES Permit until its renewal in 2021. Two additional outfalls, CSOs 103 and 208, have had separation projects completed and are in a monitoring phase. The City anticipates permanent deactivation and removal from the permit in the future. CSO 211 was being evaluated for deactivation but is likely to remain in the permit until the CSO 212 Sewer Separation project is complete. One additional outfall (CSO 117) will be permanently deactivated and removed from the permit. This deactivation is anticipated before the next permit is issued in October 2021. Thus, there are currently 25 active CSO locations remaining. Figure 1-2 depicts the status of CSOs anticipated at the time of the next permit cycle.

The City's current CSS service area covers approximately 46 square miles (out of 333 square miles for the entire service area). The wastewater collection system has 1,960 miles of sewers, with approximately 720 miles of sewers for combined conveyance. These values have been updated to reflect refinements in the City geographic information system (GIS) records and reduction in CSS service area due to sewer separation as part of the LTCP.

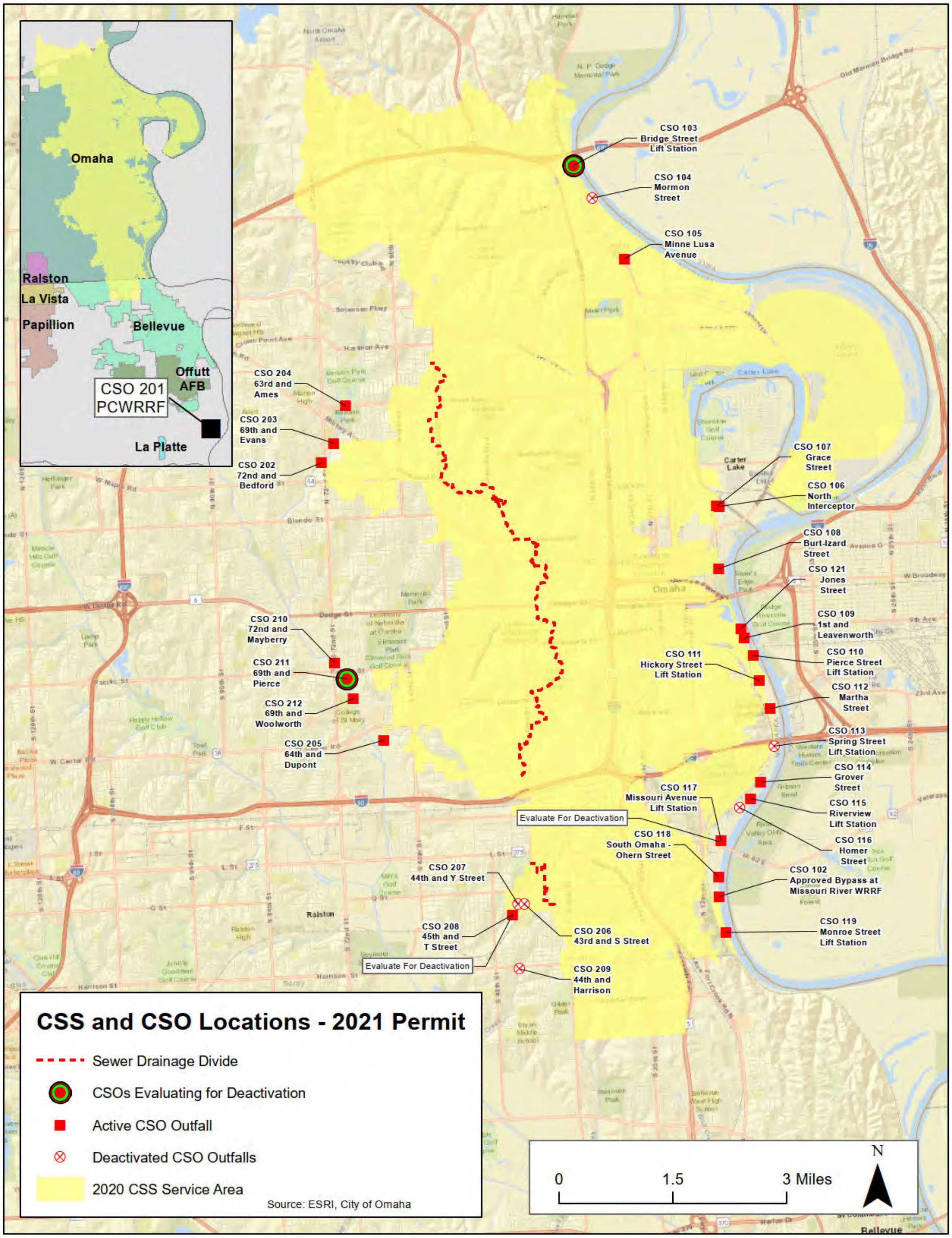

FIGURE 1-2
CSS Service Area and CSO Locations – 2021 Permit

The City's total wastewater service area is approximately 333 square miles in both Douglas and Sarpy Counties and provides service for a population of approximately 730,000. The City continues to treat wastewater in two major treatment facilities: the MRWRRF, located south of the Veterans Memorial (Highway 275) Bridge along the Missouri River, and the PCWRRF, located south of the City near Bellevue, Nebraska. A third, very small treatment facility (the Elkhorn Wastewater Treatment Plant) was recently decommissioned and the flow is now sent to the PCWRRF. A portion of the collection system for the PCWRRF and most of the collection system for the MRWRRF are considered part of the CSS.

1.2.5 Nine Minimum Controls Plan

As required in the CSO NPDES Permit, the NMC Plan includes those operations and procedures that can reduce CSOs and their effects on receiving water quality, do not require significant engineering study or major construction, and are consistent with the City's LTCP. The City and the NDEE have worked together over the last several years implementing NMCs per EPA Guidance Document 832-B-95-003, Combined Sewer Overflows - Guidance for Nine Minimum Controls (1995b), which states: "The NPDES Permitting authority should … develop and issue Phase I NPDES Permits requiring CSO communities to implement the NMCs."

"The NPDES Permitting authority should… develop and issue Phase II NPDES Permits requiring continued implementation of the NMCs and implementation of an LTCP."

"Minimum Controls are not temporary measures; they should be part of long-term efforts to control CSOs."

On October 1, 2002, the NDEE issued a CSO Phase I Permit to the City, which contained a series of required submittals and reporting requirements that demonstrated the development and initial implementation of the NMCs. Summaries of the NMC objectives and required submittals are on record in the City's 2007 Combined Sewer Overflow Permit Annual Report NPDES Permit No. NE0133680. The collection of submittals and reports are on file at the City's Sewer Maintenance Division and are referred to in this report as the NMC Plan.

On October 1, 2007, the NDEE issued the Phase II CSO Permit to the City. Subsequent CSO Program-related permits were issued in 2010 and 2015, which continue to fulfill the documentation and reporting requirements to assure the NMCs are met in accordance with the following:

- The initial NMC submittals that were a part of the Phase I Permit, as documented in the 2007 CSO Annual Report, and modifications/updates to those initial submittals along with subsequent CSO Annual Reports.
- EPA NMC Guidance.
- EPA CSO Control Policy (April 19, 1994, at 59 Fed. Reg. 18688).

The City has continued to implement the NMCs in accordance with the submittals on record with the NDEE and in accordance with EPA guidance and policy. In addition, the City is currently in the process of updating the NMC documentation. This NMC documentation can be used to update NDEE with the status of NMC element efforts, some of which may be incorporated into future LTCP Updates and future CSO Permits as appropriate.

1.3 Challenges in the LTCP Implementation

Over the last 15 years since the City began implementing the CSO Program, the City has made significant progress in addressing the CSOs. Some of the major accomplishments include the following:

- As a result of the construction of the Industrial Lift Station and Force Main and modifications to the MRWRRF, high-strength industrial waste no longer overflows into the Missouri River during storm events. This resulted in an estimated 26 percent reduction in *E. coli* discharged from the CSS.
- Modifications have been made to the MRWRRF to treat more wet weather flows through the secondary process and through the primary treatment system, including the addition of a chlorine contact basin for primary effluent. In addition, modifications were made to the system that conveys wet weather flows to the plant. This included the construction of a new Leavenworth Lift Station and a new SIFM. This has resulted in more wet weather flows being conveyed to the MRWRRF and treatment being provided through both the secondary treatment system and through the primary clarifiers with disinfection and dechlorination before discharge into the river. This, along with the removal of the industrial waste, has resulted in a 52 percent reduction of *E. coli* discharged from the combined system.
- Significant areas of the combined system, particularly in the Papillion Creek Watershed, have been separated. This has resulted in a reduction of the amount of combined sewage overflowing into the Missouri River and Papillion Creek drainages.
- Through the CSO Program, several public amenities have been updated and expanded (for example, Adams and Fontenelle Parks). This has not only provided investments in the community but achieved the goals of the CSO Program while saving the City over $8 million through the inclusion of green infrastructure rather than gray infrastructure. Figure 1-3 shows the Fontenelle Park Lagoon.

FIGURE 1-3
Fontenelle Park Lagoon

The City has also faced several major challenges in recent years in the implementation of the Program. These are discussed in greater detail in Section 2 and include as follows:

- Two major floods in 2011 and 2019.
- The bids for several projects, came in significantly over the engineers' estimates and had only one bidder.
- Completion of the SIFM North Segment was delayed as the result of the tunnel boring machine encountering a geologic anomaly, which resulted in it becoming stuck under the Heartland of America Park, a former CERCLA[2] site.
- The growing economy has resulted in an increase in prices for projects and a reduction in the number of contractors bidding on projects.
- Accommodating outside utilities has resulted in significant delays in the projects.
- COVID-19 – Currently the City is dealing with the effects of a worldwide pandemic.

Overall, the CSO Program has resulted in improvement in water quality. While there have been challenges, the City has been able to keep the Program on track and within the original timeframes or agreed upon modified timeframes and budget.

2 CERCLA stands for the Comprehensive Environmental Response, Compensation, and Liability Act, known also as Superfund.

1.4 LTCP Update Approach

This 2021 LTCP Update builds on the 2009 LTCP and 2014 LTCP Update. It has been structured slightly differently than the previous LTCPs. This includes organizing the discussion by the CSO Outfalls rather than the Watersheds and relying on attached memorandums to provide details rather than detailed explanations in the LTCP body.

1.5 Adaptive Management of the LTCP

As has been stated in previous LTCPs, this is a plan, not a design document, and many of the factors that affect this plan will change over time. For this reason, the City uses an adaptive management strategy in implementing the LTCP. Adaptive management, as defined by the EPA, is “the process by which new information about the health of a watershed is incorporated into the watershed management plan.” The City has applied this process to the LTCP and implementation of individual controls within the LTCP by following these simple steps (Figure 1-4):

Step 1 – Implement
Step 2 – Monitor
Step 3 – Evaluate
Step 4 – Adapt

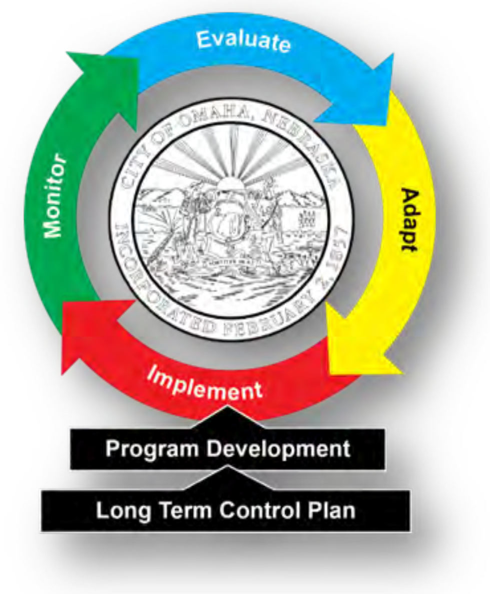

FIGURE 1-4
Adaptive Management Strategy for Implementing the LTCP

2 Current Status of the Program

2.1 Introduction

The City of Omaha (City) has made significant progress in the implementation of the CSO Program (Program) since 2009. Through February 2021, the City has paid $758 million to implement the LTCP. Approximately $477 million of this amount has been for construction. The City has awarded, or is currently bidding, more than $598 million in construction contracts, and nearly 90 percent of that contracted amount has been successfully won by local Omaha general contractors. Another $131 million in construction value is currently under design. More than 26 of the 59 projects in the 2014 Long Term Control Plan (LTCP) Update have been completed, with another 13, that will be completed during the next permit term (2021 through 2026), including the system reliability projects. This section provides a description of the status of projects associated with each of the combined sewer overflow (CSO) outfalls. It provides an overview of the projects completed, those currently being designed or under construction, and those that are expected to be completed by March 31, 2021.

This section also includes a summary of the CSO collection system hydraulic modeling, flow monitoring, water quality monitoring, and water quality modeling. A summary of the current water quality of the streams receiving CSO and an update to the sensitive areas are also included.

Lastly, the section provides additional details on some of the key challenges noted in Section 2.8 that the City has faced to achieve this progress.

2.2 Implementation Status

This section addresses compliance with the LTCP schedule and the CSO Permit compliance dates. As part of the 2019 Annual Report, the City evaluated the percent by volume of the combined sewage collected in the combined sewer system (CSS) during precipitation events on a systemwide annual average basis that has been eliminated or captured for treatment. This analysis used the representative year rainfall (to evaluate average conditions) with an InfoWorks model simulation of the sewer system as it existed at the end of 2019.

In the Missouri River Watershed (MRW), the results from the 2019 model showed the following:

- A 56 percent capture of representative year wet weather volume as compared to 30 percent under 2002 Existing Conditions
- A significant increase in flow receiving secondary treatment during wet weather due to increased treatment capacity at the Missouri River Water Resource Recovery Facility (MRWRRF) and increased pumping capacity at the new Leavenworth Lift Station; the volume receiving secondary treatment was 40 percent greater than in 2002 (Existing Conditions)

In addition, the following projects are in construction or design that will significantly boost the percent capture to approximately 70 percent:

- Burt-Izard Lift Station (in construction) – will increase pumping capacity from 25 to 50 million gallons per day (MGD).
- Riverview Lift Station (in construction) – will increase pumping capacity from 3.5 to 7 MGD.
- Monroe Lift Station (in design) – will increase pumping capacity from 40 to 65 MGD.
- Monroe South Barrel Separation (in design) – will isolate the Monroe South Barrel for stormwater flows and significantly reduce combined sewage volume at CSO 119.

In the Papillion Creek Watershed (PCW), the 2019 model showed 84 percent capture of representative year wet weather volume (compared to 78 percent capture for 2002 Existing Conditions). The increased capture is due to sewer separation projects (including the elimination of CSOs 207 and 209) and increased flow to Papillion Creek Water Resource Recovery Facility (PCWRRF).

Several sewer separation projects are currently in design or construction in the PCW, including CSOs 202, 203, 210, 211,212 and portions of 204. In addition, construction has started on the Saddle Creek Retention Treatment Basin (SCRTB) at CSO 205, which will significantly improve water quality in the watershed in the next few years.

2.2.1 Compliance with Permit Dates

The City's CSO Permit includes compliance dates for the different project phases for Major Projects and Sewer Separation Projects. These compliance dates are based on the various phases that were provided in Section 5.5, LTCP Update Implementation Schedule of the 2014 LTCP Update, and along with subsequent modifications of the CSO Permit and LTCP. Table 2-1 provides a summary of all the phases in the 2014 LTCP Update as well as Part VI of the CSO Permit and their anticipated compliance status for Major Projects through March 2021. Table 2-1 demonstrates the overall success of LTCP implementation to date and shows that the Program has met the compliance dates included in the current CSO Permit. Requirements in the current CSO Permit as milestone dates are in **bold**. Comments in Table 2-1 only reflect the requirements in the current permit. As noted in the CSO Permit modifications, alternative projects were identified for the Minne Lusa Basin, and the Phase 3 Major Projects have been removed.

TABLE 2-1
LTCP and CSO Permit Compliance Status for Major Projects

Milestone (Permit Reference)	Compliance Date	Date Achieved	LTCP Project That Achieved Compliance Date	Comment
Phase 1 Major Projects, in the LTCP, Begin Final Design	December 31, 2009	September 1, 2009	Ohern/Monroe Industrial Flow Area Sewer Separation Project	
Phase 1 Major Projects in the LTCP, Begin Construction	December 31, 2010	June 8, 2010	Ohern/Monroe Industrial Flow Area Sewer Separation Project	
Phase 1, Major Projects, All Projects Operational	**December 31, 2019**	December 12, 2019	MRWRRF Improvements	Schedule B2 construction contract achieved this date by completing the MRWRRF Improvements project
Phase 2, Major Projects in the LTCP, Begin Final Design	December 31, 2010	September 30, 2010	Aksarben Village Phases A and B	
Phase 2 Major Projects in the LTCP, Begin Construction	December 31, 2011	September 29, 2011	Aksarben Village Phases A and B	
Phase 2 Major Projects in the LTCP, All Projects Operational	**December 31, 2023**	N/A		The SCRTB is currently under construction and is expected to meet the compliance date
Phase 4 Major Projects in the LTCP, Begin Final Design	**December 31, 2023**	N/A		This date was in the CSO Permit but was changed from December 31, 2019 to December 31, 2023 in November 2019 permit modification
Phase 4, Major Projects in the LTCP, Begin construction	December 31, 2023	N/A		Not in the current permit
Phase 4 Major Projects in the LTCP, Complete construction	September 30, 2021	N/A		Not in the current permit

N/A = not applicable

Table 2-2 provides a summary of the phases from the LTCP and CSO Permit and their anticipated compliance status for Sewer Separation Projects through March 2021. Requirements that were incorporated in the CSO Permit as compliance schedule dates are in **bold**. As with Table 2-1, Table 2-2 demonstrates that the CSO Permit Requirements have been achieved. The dates for these projects will be modified as part of the next CSO Permit.

TABLE 2-2
LTCP and CSO Permit Compliance Status for Sewer Separation Projects

Milestone (Permit Reference)	Compliance Date	Date Achieved	LTCP Project That Achieved Compliance Date	Comment
Phase 1, Sewer Separation Projects in the LTCP, Begin Bidding	December 31, 2009	January 1, 2009	Webster Street Sewer Separation Phase 2	
Phase 1, Sewer Separation Projects in the LTCP, Complete Construction	December 31, 2011	January 10, 2011	24th Street & Ogden Street Sewer Separation	
Phase 2, Sewer Separation in the LTCP, Begin Bidding	December 31, 2011	January 26, 2011	Spring Street Sewer Separation	
Phase 2, Sewer Separation in the LTCP, Complete Construction	**September 30, 2017**	November 30, 2016	John A. Creighton Boulevard (JCB) & Miami Phases 1 & 2 and Adams Park Improvements	
Phase 3, Sewer Separation in the LTCP, Begin Bidding	December 31, 2014	January 8, 2014	Missouri Avenue Sewer Separation Phase 1	
Phase 3, Sewer Separation in the LTCP, Complete Construction	**December 31, 2018**	December 21, 2017	Gilmore Avenue Phase 1 & 2	
Phase 4, Sewer Separation in the LTCP, Begin Bidding	**December 31, 2016**	October 5, 2016	Lake James to Fontenelle Park	
Phase 4 Sewer Separation in the LTCP, Complete Construction	June 30, 2022	N/A		Not in the current permit
Phase 5, Sewer Separation in the LTCP, Begin Bidding	**December 31, 2019**	November 28, 2018	CSO 202 Phase 1	
Phase 5, Sewer Separation in the LTCP, Complete Construction	December 31, 2023	N/A		Not in the current permit

TABLE 2-2
LTCP and CSO Permit Compliance Status for Sewer Separation Projects

Milestone (Permit Reference)	Compliance Date	Date Achieved	LTCP Project That Achieved Compliance Date	Comment
Phase 6, Sewer Separation in the LTCP, Begin Bidding (Part VI.J)	**December 31, 2021**	N/A		Date was changed from June 30, 2020 to December 31, 2021 in November 2019 permit modification
Phase 6, Sewer Separation in the LTCP, Complete Construction	December 31, 2023	N/A		Not in the current permit
Phase 7, Sewer Separation in the LTCP, Begin Bidding (Part VI.J)	June 30, 2022	N/A		Not in the current permit
Phase 7, Sewer Separation in the LTCP, Complete Construction	September 30, 2027	N/A		Not in the current permit

2.2.2 Missouri River Watershed

Most of the sewers within the MRW in Omaha were constructed as combined sewers. The watershed was divided into six basins as part of the development of the 2009 LTCP. These basins are the Bridge Street, Minne Lusa, Burt-Izard, Leavenworth, South Interceptor, and Ohern/Monroe basins. Within the CSS basins in the MRW, there are some areas with separate storm and sanitary sewers. In some cases, the separation is localized, and the separate sewers recombine downstream of the separated area; however, in other cases, the stormwater is carried out of the sewer system via dedicated stormwater pipes directly to receiving waters. There are 19 CSO outfalls in the watershed.

Following is a summary of projects in the watershed that have been completed, are under construction, or under design as of March 2021 for each outfall. As previously noted, as of the end of 2019, approximately 56 percent of the representative year wet weather volume is captured within the watershed. The CSO outfall names are those included in the City's CSO Permit.

2.2.2.1 CSO 102 – Bypass at Missouri River Water Resource Recovery Facility

CSO 102 is a wet weather bypass from the primary clarifiers that is permitted and treated as a CSO in the CSO Permit. This overflow occurs when wet weather flows into the plant exceed the capacity of the secondary treatment process. The following projects consist of improvements in conveyance so that additional flows can be sent to the MRWRRF, as well as improvements at the MRWRRF that provide dedicated primary and secondary treatment of industrial flows, pump improvements to maximize flow rates through secondary treatment, and treatment of the flows discharged through CSO 102. These projects maximize the use of existing infrastructure and maximize flow to the MRWRRF.

Missouri River Water Resource Recovery Facility Improvements (Completed)

The MRWRRF Improvements project was delivered under three major construction contracts. Figure 2-1 shows the finished MRWRRF Project. The MRWRRF Improvements Project included:

FIGURE 2-1
Missouri River Water Resource Recovery Facility 2020

- Providing separate primary treatment of the high-strength waste from the South Omaha Industrial Area (SOIA) at the SOIA Headworks, which is conveyed by the Industrial Lift Station (also known as the SOIA Lift Station), Force Main, and Gravity Sewer.
- Modifying the Transfer Lift Station so that the high-strength waste can go directly to the secondary treatment system. The capacity of the Transfer Lift Station pumps was increased to enable the ability to convey 64 MGD of primary effluent to the secondary system.
- Constructing a new headworks facility (Municipal Headworks) that has a peak-hour capacity of 150 MGD.
- Modifying the In-Plant Lift Station to improve the pumping operations and increase capacity.
- Constructing a Chlorine Contact Basin and associated chemical feed system to provide disinfection of wet weather flows for CSO 102, which exceed secondary treatment capacity. This project includes chlorination and dechlorination of the primary clarifier effluent prior to discharge through CSO 102 to the river during wet weather events.

The MRWRRF improvements were completed on December 12, 2019. The City has until January 1, 2023 to fine-tune the operation of the wet weather system prior to effluent limits on *E. coli* and total residual chlorine becoming effective.

South Interceptor Force Main (Completed)

The original South Interceptor Force Main (SIFM) was constructed in the early 1960s and its condition made it unreliable for continued long-term use. Replacement was necessary to reliably convey both dry- and increased wet weather flows to the MRWRRF. The new SIFM provides needed reliability and increased flow capacity. The new SIFM consists of approximately 4,360 feet of 42-inch and 48-inch diameter pipe from the north connection to the old SIFM south of the I-480 Bridge to the new Leavenworth Lift Station, and approximately 18,400 feet of 64-inch diameter pipe from the Leavenworth Lift Station south to the MRWRRF. The project also included the North Gravity Sewer that conveys flow from the existing Leavenworth Trunk Sewer to the new Leavenworth Lift Station. Construction started on the project on January 9, 2014 and was complete on January 18, 2018.

The SIFM project was constructed under two construction contracts. The northern portion of the new SIFM (old SIFM south of the I-480 Bridge to the new Leavenworth Lift Station) is not currently in operation because the Burt-Izard Lift Station Improvements must be completed before this segment is placed into operation to mitigate grit deposition in the force main. It is expected that this segment will be put into operation in the fall of 2021.

MRWRRF Conveyance Improvements (Under Design or Construction)

Lift station improvements increase the conveyance capacity of the system to send more flow to the MRWRRF for treatment. These lift stations include the Burt-Izard Lift Station located at CSO 108, new Leavenworth Lift Station located at CSO 109, the new SOIA Lift Station and force main and gravity sewer, the new Riverview Lift Station under construction at CSO 115, and the expansion and improvements to the Monroe Lift Station at CSO 119. These projects are discussed later in this section.

2.2.2.2 CSO 103 – Bridge Street Lift Station

The 36th Street Sewer Separation Project and a project for improvements to the Bridge Street Lift Station affect CSO 103. Following is a discussion of the sewer separation project; the Lift Station has not been designed and will be removed from the LTCP, as is further discussed in Section 3. The CSO 103 outfall is being monitored with a goal of deactivation.

36th Street Sewer Separation (Completed)

The purpose of the 36th Street Sewer Separation Project (OPW 51698) was to separate the existing combined sewer on 36th Street between State and McKinley Streets. The existing combined sewer on 36th Street collected both sanitary flow from adjacent residential properties and stormwater flow from ditches adjacent to the roadway. For this project, a new 18-inch to 24-inch diameter storm sewer was constructed parallel to the existing combined sewer in 36th Street. Existing stormwater inlets were disconnected from the existing combined sewer and connected to the new storm sewer. The former combined sewer remains in place and serves as a sanitary sewer for the area. The project reduces peak flows and volume to the Bridge Street Lift Station. The project was completed on December 8, 2014.

2.2.2.3 CSO 104 – Mormon Street

This outfall was deactivated in July 2014. No CSO Program projects were constructed within the basin, but the City constructed some sewer separation projects in the area outside of the CSO Program.

2.2.2.4 CSO 105 – Minne Lusa Avenue

The CSO 105 – Minne Lusa Avenue outfall, shown on Figure 2-2, receives flow from the Minne Lusa Basin (which includes an area tributary to the former CSO 104 – Mormon St) as well as flow from the Bridge Street Basin. Multiple sewer separation and green infrastructure projects have been completed or are currently underway. Green infrastructure projects include those completed at Fontenelle Park, Adams Park, and Miller Park that provide detention of stormwater to attenuate the peak flows from wet weather events. The projects have significantly removed stormwater from the system and have also provided community benefits.

FIGURE 2-2
CSO 105 Minne Lusa Avenue Discharge during a June 2014 Storm

Forest Lawn Creek Inflow Removal and Outfall Storm Sewer (Under Redesign)

The Forest Lawn Sewer Separation project will remove the Forest Lawn Creek and wet weather flows from the CSS and convey those flows through a separate storm sewer system to the Missouri River. This project was originally bid on October 31, 2018, and the bids were opened on February 27, 2019. Only one bid was received, and it significantly exceeded the engineer's opinion of probable construction costs (OPCC). The City rejected the bid and performed a value engineering (VE) review to identify the factors contributing to the high bid and to assess if there are actions that can be taken to reduce the cost of the project. The results of the VE review estimated that the cost of the project, if re-bid, would range between $21 and $26 million. Section 3 provides a description of the evaluations that were done to confirm that this project should move forward. This project began redesign in March 2021.

Miller Park to Pershing Detention Basin Sewer Separation (Completed)

The Miller Park to Pershing Detention Basin Sewer Separation project (OPW 51941), located in the easterly portion of the Minne Lusa Basin, diverts separated stormwater that was previously discharged into the downstream CSS to the Pershing Detention Basin from Miller Park. Stormwater overflows are diverted from the Miller Park Pond, which is a wet detention pond, to the Pershing Detention Basin where water quality is improved prior to flows being conveyed to the Missouri River. Project work included construction of approximately 2,300 feet of 60-inch stormwater conveyance sewer between the pond and basin. Modifications to the existing Miller Park Pond outlet structure and construction of a new inlet into the Pershing Detention Basin were also included in the project. This project reduces flows in the CSS and reduces the size of required downstream controls.

Construction started on July 8, 2013 and was completed on June 8, 2014.

24th Street and Ogden Street Sewer Separation (Completed)

The 24th Street and Ogden Street Sewer Separation Project (OPW 51497) is in the easterly portion of the Minne Lusa Basin. The project provided sewer separation to this sub-basin area and directed separated stormwater flows to the Pershing Detention Basin, thereby reducing peak combined flow rates and volume in the remaining combined system to CSO 105. The separated area is bounded on the north by Kansas Avenue, on the east by

Florence Boulevard, on the south by Fort Street, and on the west by 25th Avenue. Construction started on May 12, 2010 and was complete on January 10, 2011.

Minne Lusa – 105-1 JCB & Miami Phase 1 and Phase 2 and Adams Park (Completed)

The Minne Lusa – 105-1 JCB & Miami Phase 1 project (OPW 52165) is also known by its City project name: JCB & Miami Street Sewer Separation. The project included the Minne Lusa – 105-1 JCB & Miami Phase 2 project (OPW 52165) identified in the 2009 LTCP. These projects were implemented in one construction project that separated a substantial area in the Minne Lusa Basin and directed the separated stormwater into a new wetland and wet detention basin in Adams Park. The project included construction of a storm sewer to allow for conversion of the existing combined sewer to sanitary sewer within the sewer separation area. The project is bounded on the north by Maple Street, on the east by 32nd Street, on the south by Hamilton Street, and on the west by 40th Street. It reduced the flow rate and volume in the downstream combined sewer.

FIGURE 2-3
Adams Park Lagoon

The Adams Park detention facility, as shown on Figure 2-3, consists of a pretreatment channel on the south side of the park and wetlands on the north side of the park. The wetlands consist of shallow and deeper permanent pool areas, emergent wetland areas that are inundated during small storm events, and upland areas that are inundated only during major storm events. The embankment creating the detention facility is categorized as a high hazard dam. The dam and emergency spillway are located on the north side of the park near Bedford Avenue. This facility provides water quality benefits and stormwater detention that reduces peak flow rates in the downstream combined sewers.

Construction started September 3, 2014, and completion was achieved November 30, 2016.

Lake James to Fontenelle Park (Completed)

The Lake James to Fontenelle Park project reduced the risk of sewer backups and street flooding in the upstream sub-basins and reduced the wet weather flow rates into the combined sewers to reduce CSOs to the Missouri River. The project was separated into two construction projects for implementation. The first project was the Fontenelle Park Lagoon Improvements (OPW 52658), which was a green infrastructure project that modified and expanded the existing Fontenelle Park Lagoon to detain more stormwater and reduce peak flows to downstream combined sewers. The Fontenelle Park Lagoon Improvements green infrastructure project included several pretreatment best management practices (BMPs), sediment forebays, and the ability to modify the outlet structure to optimize the use of the lagoon for stormwater detention. The benefits of this green infrastructure project included providing recreational and educational opportunities for the community and reducing the amount of gray infrastructure needed for the project. The Paxton Basin Upstream Sewer Separation project (OPW 52659) provided sewer separation for three areas upstream of the Fontenelle Park Lagoon. The stormwater from the separated areas is conveyed to the Fontenelle Park Lagoon, where it is detained before discharge to the CSS. As a part of the project, Lake James Park (a dry detention basin near North 49th Street and Bedford Avenue that will hold stormwater temporarily during some storm events) was modified to provide relief to the separated storm sewers during high-intensity storms.

The Fontenelle Park Lagoon Improvements began construction on February 13, 2017 and was complete on July 28, 2018. The Lake James to Fontenelle Sewer Separation Project began construction on April 16, 2018 and was complete on December 6, 2019. Figure 2-4 shows the Fontenelle Park Lagoon.

FIGURE 2-4
Fontenelle Park Lagoon

2.2.2.5 CSO 106 – North Interceptor

The Minne Lusa Basin and North Interceptor Basin are hydraulically interconnected, so the projects completed in the Minne Lusa Basin provide benefits to the North Interceptor Basin as well by removing stormwater from the system or detaining stormwater until the peak of the event passes to improve the wet weather volume capture. This CSO basin will also benefit from increased conveyance downstream with the completion of the Burt-Izard Lift Station upgrade project currently under construction. Passive overflows can still occur at CSO 106.

No projects have been performed that effect this CSO outfall.

2.2.2.6 CSO 107 – Grace Street

The area tributary to CSO 107 – Grace Street is in the northern portion of the Burt-Izard Basin and is interconnected with the area tributary to CSO 108 – Burt-Izard Street. Combined sewer flow from the North Interceptor also impacts the Grace Street basin as flows from both areas combine downstream near the outfall points. Some projects completed in the Minne Lusa Basin and Burt-Izard Basin provide benefit to the Grace Street basin as well. Like CSO 106 – North Interceptor, this CSO basin will benefit from increased conveyance downstream with the completion of the Burt-Izard Lift Station Improvements project currently under construction. The gate previously used at times during wet weather to limit flows from the Grace Street basin to the Burt-Izard Lift Station, thereby causing an active overflow, has not been used since the new Leavenworth Lift Station began operating in 2017. Passive overflows can still occur at CSO 107.

26th & Corby Street Sewer Separation (Completed)

The 26th & Corby Sewer Separation (OPW 51778) project was a local sewer separation project that recombines with the combined system downstream. Due to the recombination of the storm and sanitary sewers, the project has minimal benefits for CSO 107 – Grace Street. A detailed description of the project is listed in the CSO 108 – Burt-Izard Street section.

Nicholas Street Sewer Extension Phase 1 (10th Street to 16th Street) (Completed)

The Nicholas Street Phase 1 (OPW 51892) project impacted both the CSO 107 – Grace Street and CSO 108 – Burt-Izard Street sub-basins. The Nicholas Street Sewer Extension Phase 1 (10th Street to 16th Street) project extended storm and sanitary sewers to provide additional sewer capacity north and west of the Convention Center, north of Nicholas Street, and to provide sewer separation for the area north from Nicholas Street on 11th Street to Clark Street. A detailed description of the project is listed in the CSO 108 – Burt-Izard Street Section.

Nicholas Street– Phase 2 (to 23rd & Grace) (Completed)

The Nicholas Street Phase 2 (OPW 52297) project impacts both the CSO 107 – Grace Street and CSO 108 – Burt-Izard Street sub-basins. The project included the extension of one of the 9-foot-diameter storm sewers from 16th and Nicholas Streets to 16th and Charles Streets and local sewer separation in Charles Street from 16th Street to 20th Street. The project also included the extension of a 24-inch sanitary sewer from 16th Street north of Nicholas Street to the 23rd & Grace Lift Station. The 23rd & Grace Lift Station was abandoned following the completion of the project. Stormwater along Charles Street from N. 21st Street to N. 22nd Street was removed from the CSS. A detailed description of the project is listed in the CSO 108 – Burt-Izard Street section.

Nicholas Street Phase 3 (Under Construction)

The Nicholas Street Phase 3 project has been broken into two phases: Phase 3A and Phase 3B. The Nicholas Street Phase 3A project provides local sewer separation that does not impact CSO 107. The Nicholas Street Phase 3B project directly impacts CSO 107 by diverting sanitary flow north of 16th and Grace Street to the Grace Street trunk sewer. The Nicholas Street Phase 3B project will separate stormwater and convey it to the Nicholas storm sewers constructed as part of Nicholas Street Phases 1 and 2. The project allows for the potential removal of a pipe plug in the future to convey the sanitary flow to the south to the Nicholas sanitary sewer and remove it from the Grace Street trunk sewer. An overflow located at 18th and Grace Street that allows high combined flows to overflow to the Grace Street trunk sewer will be removed as a part of this project. An existing sanitary connection to the combined Sewer #2 at 18th and Charles Street may also be plugged in the future, sending the sanitary flow to the Nicholas sanitary system instead. More information is included in the CSO 108 – Burt-Izard Street section.

2.2.2.7 CSO 108 – Burt-Izard Street

Webster Street Sewer Separation Phase 2 (Completed)

In 2003 (prior to the CSO Program), the City designed and constructed an extension to the Webster Street Sewer that extended the trunk and sanitary sewers to 16th Street. During the design, a hydrology and hydraulics report was completed that identified the need to relieve flows from the southern and western portions of the Burt-Izard Basin. As a result, it was determined that this extension would provide additional relief to the existing sewer systems in the upper extents of the basin and would reduce street flooding in the area. In addition, extension of the sanitary sewers would allow for potential future sewer separation in the basin.

The Webster Street Sewer Separation Phase 2 project (OPW 51503) involved the extension of the Webster Street Sewer to relieve the two existing main combined sewers (Sewer #2 and Sewer 1040) in the Burt-Izard Basin and to collect runoff from the local areas around the Convention Center area. In addition, a new parallel 30-inch sanitary sewer was constructed to serve the Burt-Izard Basin for potential future combined sewer separation.

The Webster Street Sewer Separation project was committed to by the City in advance of work on the 2009 LTCP due to redevelopment activity in the project area and to provide capacity for additional upstream sewer separation. It was complete on July 31, 2010.

Nicholas Street Sewer Extension Phase 1 (10th Street to 16th Street) (Completed)

The Nicholas Street Sewer Extension Phase 1 (10th Street to 16th Street) project (OPW 51892) extended storm and sanitary sewers to provide additional sewer capacity north and west of the Convention Center, north of Nicholas Street, and to provide sewer separation for the area north from Nicholas Street on 11th Street to Clark Street. Three 108-inch storm sewers and one 24-inch sanitary sewer were extended west from Abbott Drive from approximately 10th Street to 16th Street, following an alignment approximately one-half-block north of Nicholas Street. Both storm and sanitary sewers along 11th Street between Clark and Nicholas Streets were replaced to provide separation to this area.

FIGURE 2-5
Economy Products Building prior to Demolition

As part of the project, the abandoned four-story building (Economy Products Building) near 11th and Nicholas Streets was demolished, and 11th Street was repaved. The former Economy Products Building, shown on Figure 2-5, is part of the Economy Products Superfund site, a former pesticides manufacturer who used the building and property to manufacture, handle, and store pesticides and insecticides, resulting in contamination to the building and surrounding soil. To demolish the contaminated building, the City coordinated with Nebraska Department of Environment and Energy (NDEE) to ensure the building was adequately characterized and could be disposed of properly in the Pheasant Point Landfill. In addition to demolishing the abandoned building, contaminated soils associated with the Superfund site were excavated and disposed of properly at the Pheasant Point Landfill in accordance with all applicable rules and regulations.

Construction for the project began on February 15, 2012 and was completed on May 31, 2013.

Nicholas Street Phase 2 (to 23rd & Grace) (Completed)

The Nicholas Street Sewer Extension – Phase 2 (OPW 52297) project impacts both the CSO 107 – Grace Street and CSO 108 – Burt-Izard basins. This project included the extension of one of the 108-inch storm sewers from 16th and Nicholas Streets to 16th and Charles Streets and included local sewer separation in Charles Street from 16th Street to 20th Street. The project also included the extension of a 24-inch sanitary sewer from

16th Street north of Nicholas Street to the 23rd & Grace Lift Station. The 23rd & Grace Lift Station was abandoned following the completion of the project. This project provides separation to a significant combined sewer area, thereby reducing stormwater flow rates and volume to the existing combined sewers. Construction began on October 6, 2014 and was completed on June 24, 2016.

Webster & Nicholas Sewer Separation Phase 1 (Completed)

The Webster/Nicholas Sewer Separation Phase 1 project (OPW 51962) built upon sewer separation already completed as part of the CSO Program and was accomplished in two parts. The first part involved the construction of storm and sanitary sewer on Nicholas Street between 16th and 20th Streets. The project started with a connection to the west end of the storm and sanitary sewers constructed as part of the Nicholas Street Phase 1 project. The second part of the project included construction of one block of sanitary sewer tunneled on 15th Street from Mike Fahey Street (formerly called Webster Street) to California Street.

The project diverted stormwater flow to the Missouri River via the Nicholas Street Phase 1 storm sewers and reduced peak flow rates and volume to the existing combined system. Sanitary flows are directed to the sanitary sewer constructed as part of the Nicholas Street Sewer Extension Phase 1 project. Construction began on January 23, 2014, and construction was completed on October 13, 2015.

26th and Corby Street Sewer Separation (Completed)

The 26th and Corby Street Sewer Separation Project (OPW 51778) is in the northern portion of the Burt-Izard Basin. Due to the stormwater recombining with the combined system, the volume and peak flow rate of combined sewage was not significantly impacted within the downstream combined sewer. The project also incorporated curbside bioretention ponds along North 24th Street to reduce stormwater runoff entering the CSS, as shown on Figure 2-6. The project area is bounded by Lake Street to the south, 26th Street to the west, Spencer Street to the North, and 24th Street to the east.

FIGURE 2-6
Curbside Retention Ponds on the 26th and Corby Project

Construction began on March 26, 2014 and was completed on July 11, 2015.

Burt-Izard Lift Station (Under Construction)

The Burt-Izard Lift Station project (OPW 52472), which is a system reliability project[1] and often referred to as the Burt-Izard Lift Station Improvements project, includes the replacement of pumping equipment, addition of a second mechanical screen, replacement of all electrical and instrumentation and control equipment, an update of the facilities to meet current code requirements, and modifications to improve grit capture and removal. The

[1] A system reliability project enhances the operational reliability of the system.

existing lift station has three pumps and was originally designed for a firm capacity of 50 MGD with two pumps in operation, although in recent years it has only pumped 25 MGD due to the downstream capacity limitations of the old SIFM, treatment capacity at the MRWRRF, and inability to sufficiently remove grit and protect the pumps. The project improvements will provide a wet weather capacity of 50 MGD. The improvements to the grit removal system are critical to the operation of the North Segment of the new SIFM. The project began construction on August 22, 2018 and is expected to be complete by fall of 2021. The Burt-Izard Lift Station Improvements project is a system reliability project that does not have a permit deadline.

Nicholas Street Sewer Extension – Phase 3 (Under Construction)

Nicholas Street Sewer Extension Phase 3 is being completed in two construction phases: Phase 3A (OPW 52721) and Phase 3B (OPW 53753). The Nicholas Street Sewer Extension Phase 3A project provides sewer separation for the area bounded on the north by Clark Street, on the south by Charles Street, on the east by 16th Street, and on the west by 18th Street. The sewer separation conveys stormwater to the large diameter storm sewers constructed downstream as part of the Nicholas Street Phase 1 and Phase 2 projects. The project began construction on March 30, 2020 and was completed on September 4, 2020.

The Nicholas Street Sewer Extension – Phase 3B project is bounded on the north by Pinkney Street, on the south by Charles Street, on the east by 16th Street, and on the west by Florence Boulevard. This project will remove stormwater from the CSS and convey the stormwater to the downstream storm sewers located at 16th and Charles Street. As part of an evaluation for the Nicholas Street Sewer Extension - Phase 3 project, a more efficient sewer separation design was developed that accomplished the goals of the Nicholas Street Sewer Extension - Phase 3 project and the 18th & Seward project at a reduced overall cost. The separate 18th & Seward project is being removed from the list of projects in this 2021 LTCP Update because it is redundant. The Nicholas Street Sewer Extension - Phase 3B project was bid in spring 2021 and construction is expected to begin in the fall of 2021 and be complete in 2025.

2.2.2.8 CSO 121 – Jones Street

CSO 121 is located within the Leavenworth Basin. CSO 109 is directly impacted by Jones Street flow as combined flow from the Jones Street sewer is diverted downstream to the Leavenworth Sewer and to the Leavenworth CSO diversions. Projects constructed within the Leavenworth Basin (e.g., the new Leavenworth Lift Station) impact both the CSO 109 and CSO 121 sub-basins.

2.2.2.9 CSO 109 – 1st and Leavenworth

The Leavenworth Sewer provides service for a large portion of the Leavenworth Basin and conveys combined flows to the CSO 109 diversion and outfall (see Figure 2-7). CSO 109 ultimately serves most of the Leavenworth Basin as it also receives flow from CSO 121.

FIGURE 2-7
CSO 109 Outfall

West Hanscom Park Green Infrastructure (Completed)

The West Hanscom Park Green Infrastructure project (OPW 52781) included the construction of a dry detention basin, two bioretention ponds, and modifications to the existing Hanscom Park Lagoon. These green infrastructure practices manage stormwater from a drainage area of approximately 99 acres. Stormwater from the west of Hanscom Park along Center Street and Frances Street was routed to Hanscom Park with the construction of new storm sewers. This stormwater is then stored and infiltrated within the dry detention and bioretention ponds. Stormwater that overflows the dry detention and bioretention ponds will be conveyed to the Hanscom Park Lagoon. Stormwater from the lagoon will recombine with the downstream combined sewers along Park Avenue. This project was not an LTCP project, but it was completed as a pilot green infrastructure project. During design it was estimated that it could potentially reduce up to 5 percent of the representative year wet weather volume for CSO 109 through infiltration, evapotranspiration, and offsetting peak flows through detention.

Construction for the West Hanscom Park Green Infrastructure project started on October 15, 2015 and was complete on January 7, 2020. A portion of the project was also completed as part of the South 32nd Avenue Transportation project.

Leavenworth Lift Station Replacement (Completed)

Leavenworth Lift Station Replacement (OPW 51874) included the construction of a new lift station at 4th and Pierce Street and construction of new diversion structures along the existing Leavenworth Sewer outfall. As part of the project, the existing Leavenworth Lift Station at 1st and Leavenworth Street was decommissioned. The Leavenworth Lift Station Replacement project allows for the conveyance of wet weather flows up to 45 MGD to the MRWRRF for treatment. The new Leavenworth Lift Station also pumps dry-weather flows and a portion of the wet weather flows from the Pierce Street and Hickory Street basins, allowing for the decommissioning of the Pierce Street Lift Station and the future decommissioning of the Hickory Street Lift Station. Construction started on August 1, 2012. The project was operationally complete on January 12, 2015. However, the lift station did not go into operation until 2017 due to the need to first complete construction of the south and central segments of the new SIFM.

2.2.2.10 CSO 110 – Pierce Street Lift Station

CSO 110 – Pierce Street Lift Station is in the South Interceptor Basin. Dry-weather flow and some wet weather flow is currently being conveyed to the new Leavenworth Lift Station where it is pumped to the new SIFM.

Pierce Street Diversion and Lift Station (Completed)

A new diversion structure was constructed as part of the SIFM Central Segment project (OPW 52222) to convey flow from the Pierce Street basin to the Leavenworth Lift Station via the South Gravity Sewer. Modifications to a restrictor plate in the diversion were made in the Leavenworth Lift Station Flood Mitigation project (OPW 52783) to limit flows to the lift station because the Pierce Street basin still has combined sewers. The new diversion structure was placed online on April 21, 2020, and the existing Pierce Street Lift Station was taken out of service. Monitoring via the City's CSO device check program is now performed at the new location.

2.2.2.11 CSO 111 – Hickory Street Lift Station

CSO 111 – Hickory Street Lift Station is in the South Interceptor Basin. Dry-weather flow and some wet weather flow is currently being conveyed to the new Leavenworth Lift Station where it is pumped to the new SIFM.

Hickory Street Diversion and Lift Station (Completed)

A new diversion structure was constructed as part of the SIFM Central Segment project (OPW 52222) to direct flow from the Hickory Street basin to the Leavenworth Lift Station via the South Gravity Sewer. Modifications to the design of a restrictor plate in the diversion were made in the Leavenworth Lift Station Flood Mitigation project (OPW 52783) to limit flows to the lift station because the Hickory Street basin still has combined sewers. Beginning in April 2020, the new diversion structure (with restrictor plate) was put into operation so that most of the flows from the Hickory Street basin are now using the new diversion structure and being conveyed to the Leavenworth Lift Station. The existing Hickory Street Lift Station is currently receiving flow from the Martha Street basin and a local sanitary source. It is planned that the Hickory Street Lift Station will be taken out of service after the conclusion of the Riverview Lift Station project and the Blake Street Lift Station project, which will allow for the Martha Street basin flows to be conveyed by the new Riverview Lift Station, and another project to relocate discharges from the local sanitary source to the South Gravity Sewer. After those projects are completed, the new Hickory diversion structure will become the monitoring point for the City's device check program. The new diversion structure was placed online on April 23, 2020.

2.2.2.12 CSO 112 – Martha Street

Martha Street Sewer Separation Phase 1/Martha to Riverview Lift Station Phase 1 (Completed)

The Martha Street Sewer Separation Phase 1 LTCP project was delivered in three construction contracts, described as follows by the City project names:

- Martha Street Area Residential Combined Sewer Separation (OPW 51880)
- Lauritzen Gardens Sanitary and Storm Sewer Separation (OPW 52187)
- Lauritzen Gardens Storm Sewer Grading and CSO Abandonment (OPW 52188)

The purpose of the Martha Street Sewer Separation Phase 1 project was to separate combined sewer flow in the CSO 112 area of the South Interceptor Basin and eliminate CSOs to the CSO 112 outfall. Approximately 240 acres of the South Interceptor Basin bounded by Hickory Street on the north, the Missouri River on the east, Bancroft Street on the south, and South 9th Street on the west were separated as part of the project. The project was divided into two distinct areas for evaluation: the residential area and the Lauritzen Botanical Gardens. Lauritzen Botanical Gardens work, as shown on Figure 2-8, was completed through two construction contracts—Lauritzen Gardens Sanitary and Storm Sewer Separation and Lauritzen Gardens Storm Sewer Grading and CSO Abandonment.

FIGURE 2-8
Construction in Lauritzen Gardens

Sanitary flows from the Martha Street basin will be routed to the south through the Martha to Riverview Phase 1 sanitary sewer and the Blake Street Lift Station to then be pumped by the (new) Riverview Lift Station into the (new) SIFM. After completing the downstream construction projects, the Martha Street Lift Station will be eliminated and the diversion for CSO 112 will be monitored for deactivation of the CSO.

The Martha Street to Riverview Lift Station Phase 1 project was constructed concurrently with the three Martha Street projects due to the proximity of the projects and to accommodate sanitary flows from Martha Street to the Spring Street Lift Station. The Martha Street to Riverview Lift Station Phase 2 project has been replaced by the Blake Street Lift Station project, which will be completed concurrently with the Riverview Lift Station Replacement project. The sanitary flow from the Martha Street project was originally planned to go to the new Leavenworth Lift Station; however, the discovery of an abandoned landfill changed the concept, and this flow will now be conveyed south to the Riverview Lift Station.

Construction of the Martha Street Sewer Separation Phase 1 project was completed on November 20, 2013.

The sanitary flows from the Martha Street sub-basin are currently conveyed to the Hickory Street Lift Station via a temporary lift station, then pumped into the SIFM. When construction of the new Riverview Lift Station, Blake Street Lift Station, and related gravity piping are finished in 2022, the Martha basin flows will be conveyed instead to Riverview Lift Station. Monitoring will be done to evaluate whether the Martha Street CSO outfall can be deactivated. It is anticipated that this outfall may be closed in the next 5 years.

Martha to Riverview Lift Station Phase 2 (Blake Street Lift Station) (Under Construction)

The Blake Street Lift Station project (OPW 53270) replaces the Martha Street to Riverview Phase 2 project, which planned to use a gravity sewer to convey the flow from the Martha Street Phase 1 sewer to the Grover Street Sewer and eventually to the new Riverview Lift Station. A portion of this gravity sewer would have needed to be tunneled under multiple railroad tracks during construction. This approach was found to add significant cost and risk to the project. After further evaluation, it was determined that construction of the Blake Street Lift Station would be more cost-effective.

The Blake Street Lift Station project will convey flows from the Martha Street Phase 1 Sewer Separation project to the Blake Street Lift Station by gravity, where the flow will then be pumped to the Grover Street Sewer. This flow will then be conveyed by gravity to the new Riverview Lift Station. The Blake Street Lift Station will have a peak wet weather capacity of 1.15 MGD, which is based on the 10-year design storm. The proposed lift station will include two pumps with the option to add a third pump in the future should the City want to increase the capacity.

The bid date for the project is currently anticipated to occur in 2021.

2.2.2.13 CSO 113 - Spring Street Lift Station

Spring Street Sewer Separation (Completed)

The Spring Street Sewer Separation project (OPW 51784) provided sewer separation to this small area of the South Interceptor Basin. Sanitary flows were directed to the Spring Street Sanitary Lift Station through the construction of a sanitary sewer. The former CSO 113 Outfall was converted to a stormwater discharge to the Missouri River and CSO 113 was deactivated. Construction began on March 28, 2011, and completion of construction was achieved on December 19, 2011.

Sanitary flow from the Spring Street basin will flow by gravity to the Blake Street Lift Station and then be conveyed to the MRWRRF via the new Riverview Lift Station. The Spring Street Lift Station will be taken out of service after construction for the flow redirection is completed.

2.2.2.14 CSO 114 – Grover Street

Sanitary flow from the Martha Street basin and the Spring Street basin will flow by gravity to the Blake Street Lift Station, where it will be pumped to the Grover Street Sewer. Flow from all these basins will then be conveyed east through the Grover Street Sewer, under the BNSF Railway tracks, to a new Grover CSO diversion structure, and then south through a new 42-inch sewer to the Riverview Lift Station. Construction of the new Grover Street diversion, which will include a stoplog weir that facilitates adjustment of the diversion elevation, is part of the Riverview Lift Station project currently under construction. During storm events, the diversion structure will divert wet weather flows that exceed the system capacity to CSO 114.

2.2.2.15 CSO 115 – Riverview Lift Station

Riverview Lift Station Replacement (Under Construction)

The Riverview Lift Station Replacement (OPW 52402) project (Figure 2-9) includes the construction of a 42-inch combined sewer (referred to as the Gibson Road Sewer), two new diversion structures (one of which is the Grover Street diversion described above), and the new Riverview Lift Station. The Gibson Road Sewer will convey flows from the Martha Street, Spring Street, and Grover Street sub-basins to the new Riverview Lift Station. A new Riverview diversion structure, which will include a stoplog weir that facilitates adjustment of the diversion elevation, will be constructed on the existing Riverview Park combined sewer to divert flow to the new Riverview Lift Station. Flow exceeding the lift station capacity will be diverted to CSO 115 during storm events. The old Riverview Lift Station will be removed from service after the new lift station is completed.

FIGURE 2-9
Riverview Lift Station Under Construction in January 2021 (Courtesy of Mulitvista)

The Riverview Lift Station Replacement project began construction on March 3, 2020 and is expected to be completed in 2022. The Riverview Lift Station project is a system reliability project that does not have an LTCP deadline and is not tied to a milestone.

2.2.2.16 CSO 117 – Missouri Avenue Lift Station

Missouri Avenue Sewer Separation Phase 1 (Completed)

The Missouri Avenue Sewer Separation Phase 1 project (OPW 51997) is also known by its City project name of Missouri Avenue/Spring Lake Sewer Separation. The Phase 1 project along with the Phase 2 project provides sewer separation to the entire 416-acre Missouri Avenue sub-basin through a combination of new storm and new sanitary sewers. Sanitary flows are directed to the existing Missouri Avenue Lift Station, while storm flows are conveyed to the Missouri River through the former combined sewer, which will be converted to a storm sewer following completion of the Missouri Avenue Phase 2 Sewer Separation project. The Phase 1 project included construction of multiple

FIGURE 2-10
Spring Lake Park in July 2017

green infrastructure facilities (Figure 2-10) upstream of a multi-use pond within Spring Lake Park to provide detention of stormwater runoff to reduce downstream stormwater flows and to allow the continued use of the combined sewer as a storm sewer following completion of the sewer separation. The Phase 1 project also included construction of green infrastructure within Spring Lake Park to provide water quality benefits and stormwater attenuation.

Construction commenced on April 29, 2014, and completion was achieved on July 29, 2016.

Missouri Avenue Sewer Separation Phase 2 (Under Construction)

The Missouri Avenue Sewer Separation Phase 2 project expands on the Missouri Avenue Sewer Separation Phase 1 project with the construction of new sanitary sewers, storm sewers, and green infrastructure detention basins. This project provides sewer separation for the area upstream of the Spring Lake Park Golf Course and south of Spring Lake Park. The separated stormwater from upstream of the golf course is sent to the detention and infiltration basins constructed within the Spring Lake Park Golf Course. Stormwater that originates from upstream of South 16th and F Street flows to the detention basin south of the "F" Street Dam, after which it enters the former combined sewer that will be converted to a storm sewer at the conclusion of the Phase 2 project. CSO 117 will be deactivated at the end of the project, and the outfall will become a storm outfall.

The Phase 2 project began construction on October 10, 2017 and is anticipated to reach completion by October 1, 2021.

2.2.2.17 CSO 118 – South Omaha - Ohern Street

The Ohern Street basin includes the SOIA Lift Station (Figure 2-11), where high-strength waste is conveyed to the MRWRRF for treatment. Major projects were constructed that provided dedicated conveyance and primary treatment of the high-strength waste. These projects provide a considerable benefit to the water quality of the Missouri River by significantly reducing the *E. coli* being discharged to the river.

Ohern/Monroe Industrial Flow Area Sewer Separation (Completed)

The Ohern/Monroe Industrial Flow Area Sewer Separation project (OPW 51861) removed industrial discharges from the existing CSS within the Ohern/Monroe Basin and delivered flows to the Industrial Lift Station. This project, which is referred to by the City project name of South Omaha Industrial Area Sewer Separation (SOIASS), involved sanitary and storm sewer separation as well as cleaning of existing sewer lines. Construction of the SOIASS project started on June 8, 2010 and was completed on November 3, 2010.

FIGURE 2-11
South Omaha Industrial Area Lift Station

Ohern/Monroe Industrial Lift Station, Force Main, and Gravity Sewer (Completed)

The Ohern/Monroe Industrial Lift Station, Force Main, and Gravity Sewer project was bid in two separate construction contracts because of the differences in the types of construction required for the two projects. The following construction contracts are listed by their City project names:

a) SOIA Lift Station (OPW 51596) (Contract 1)
b) SOIA Force Main and Gravity Sewer (OPW 51597) (Contract 2)

The SOIA Lift Station project provides screening and pumping of the separated high-strength industrial flows, from the SOIA Lift Station directly to the MRWRRF through the SOIA Force Main and Gravity Sewer. The force main extends from the lift station east to a high point along 13th Street where it converts to the gravity sewer that conveys flow to the previously described SOIA Headworks facility at the MRWRRF. Construction of the lift station (OPW 51956) began on October 3, 2011 and was completed on May 16, 2014. Construction of the force main and gravity sewer (OPW 51957) began on August 31, 2011 and was completed on May 16, 2014.

A grit removal basin was originally planned to be included at the SOIA Lift Station but was instead constructed at the MRWRRF in the previously described SOIA Headworks. This change was made because of the potential odor associated with pretreatment of this waste. It was determined that it would be easier and more acceptable to the public for operations and maintenance to handle these materials directly at the MRWRRF.

2.2.2.18 CSO 119 – Monroe Street Lift Station

Gilmore Avenue Sewer Separation Phases 1 & 2 (Completed)

The Gilmore Avenue Sewer Separation Phase 1 project (OPW 52184) was combined with the Gilmore Avenue Sewer Separation Phase 2 project as noted in the 2014 LTCP Update. The combined project provided sewer separation to an approximately 226-acre area in the Ohern/Monroe Basin and included the abandonment of some existing pipes, rehabilitation, and construction of new storm and sanitary sewers. The newly constructed and rehabilitated sewers convey stormwater flow to the Monroe South Barrel and sanitary flows to the Monroe North Barrel. This separation directed overland creek flow entering the sewer system from Sarpy County to the Monroe South Barrel, which will convey primarily stormwater to the Missouri River in the future. The Gilmore Avenue Sewer Separation project incorporated green infrastructure (a detention basin, see Figure 2-12) that decreased the size of necessary downstream storm sewers and offered benefits to neighborhood residents. Construction began on July 20, 2015 and was completed on December 21, 2017.

FIGURE 2-12
Gilmore Detention Basin

Monroe Street Lift Station (Under Design)

The Monroe Street Lift Station (OPW 53082) project includes the replacement of pumping equipment, updates to the facility to meet current code requirements, modifications to improve grit removal, and improvements at the diversion structure. The lift station was previously designed to receive the industrial flows from SOIA. These industrial flows have since been rerouted, and the lift station currently operates at a maximum wet weather flow of 40 MGD. This project will upgrade the pumping capacity to 65 MGD to the MRWRRF. The Monroe Street Lift Station is a system reliability project.

The project is currently in final design and is expected to start construction in 2021 and be completed in 2023.

CSO 119 South Barrel Conversion & Sewer Separation (Formerly South Barrel 5A & 5B Conversion) (Under Design)

The South Barrel 5A & 5B projects (OPW 53149) are two sewer separation projects that will eliminate combined flow to the South Barrel of the CSO 119 outfall sewer during the representative year. The focus area of the projects includes two large diameter combined sewers known as the Monroe North and South Barrels. The North Barrel conveys combined flow to the CSO 119 diversion structure, where it is conveyed to the Monroe Lift Station or to the Missouri River during a CSO event. The North Barrel previously conveyed industrial flows from SOIA, but the flows were separated from the CSS as a part of the SOIA improvements for storms up to the 10-year design event; for larger storms, overflows from SOIA to the North Barrel can occur. The South Barrel conveys combined flow to the North Barrel during low flows through two diversion structures located near South 15th and South 17th Street along Monroe Street. During high flows, combined flow can enter the South Barrel at these diversions and discharge to the Missouri River at CSO 119. The goal of this project is to convert the South Barrel to a storm sewer, except during large storm events beyond the representative year storm sizes when combined flows would be able to enter the South Barrel via a potential connection that will be monitored as CSO between the North and South Barrels near Railroad Avenue and Madison Street, which is currently under design. Two sets of hydraulic windows that currently connect the North and South Barrels will be closed. The new, more accessible, maintainable, and monitorable connection planned to be constructed between the barrels will activate only for large storms and not the representative year. All other sources of sanitary or combined flow to the South Barrel will be closed. Two existing diversion structures near South 15th Street and South 17th Street along Monroe Street will be closed, and additional neighborhood sewer separation will be conducted.

The project is currently under design and is expected to be completed in 2026.

2.2.3 Papillion Creek Watershed

The PCW described in this document is the collection of combined sewers that flow into the Papillion Creek Interceptor and to the Papillion Creek WRRF. The 2019 model showed 84 percent capture of representative year wet weather volume, as previously noted. The outfalls in the PCW include CSOs 201 through 205, and CSOs 207 through 212; CSO 206 will not be discussed in this section as it has been closed for an extended period. Included in the PCW is the Cole Creek Sub-basin, which will be discussed in the following section.

2.2.3.1 CSO 201 – Papillion Creek Water Resource Recovery Facility Interceptor

The PCWRRF is located south of the City near Bellevue, Nebraska and treats wet weather flow from the Papillion Creek collection system. The PCWRRF treats approximately 70 MGD dry-weather flow. During wet weather, a flow rate between 105 and 135 MGD, is typically sent to the plant from the gate structure located immediately outside of the plant’s south fence. This entire flow is treated through secondary treatment and disinfection. Flows in the Papillion Creek Interceptor higher than the flow that can be treated by the plant are released through CSO 201 – PCWRRF Interceptor by opening a gate. However, overflows at this location are rare, as the interceptor has some storage capacity that is utilized when possible to minimize CSOs.

The City has recently completed a Water Resource Recovery Facility Master Plan (City of Omaha, 2021), which evaluated the wet weather capacity of the plant and recommended increasing the influent flow rate to a peak of 190 MGD. This is discussed further in Section 3.

2.2.3.2 CSO 205 – 64th and Dupont

There are three projects that address overflows from CSO 205. These include the Bohemian Cemetery project and Aksarben Village Phases A and B, which are complete, as well as the SCRTB, which is currently under construction.

Bohemian Cemetery (Completed)

The Bohemian Cemetery project is also referred to by its City project name: Saddle Creek Area – 55th to 64th Street Sewer Separation project (OPW 51777). The project removed an unnamed creek from the CSS and removed stormwater from the CSS from an area bounded on the north by Center Street, on the east by 45th Street, on the south by Grover Street, and on the west by 60th Street. The removed stormwater is conveyed to the Little Papillion Creek via a new storm sewer outfall. The project reduced combined sewer flow in the Papillion Creek sewer system and eliminated some stormwater flow that previously reached the PCWRRF. In addition, this project also reduced the volume of combined sewer flows that will need to be controlled by the SCRTB. Construction for Saddle Creek Area – 55th to 64th Street Sewer Separation project started on December 17, 2012, and complete on May 22, 2014.

This project included two green infrastructure features (Figure 2-13). A detention basin and wetland system constructed in the Westlawn-Hillcrest Cemetery was designed to reduce the peak flow rates from the creek, reducing the required downstream storm sewer size. A second feature, constructed at the west end of the project between approximately 62nd and 64th Streets, is an open channel, where the flows were day-lighted to produce a more natural feature with aquatic habitat.

FIGURE 2-13
Saddle Creek East Wetlands

Aksarben Village Phases A and B (Completed)

The Aksarben Village Neighborhood Sewer Separation project (OPW 51151) included the construction of new storm sewers north and east from the 63rd and Shirley intersection to approximately 56th and Marcy Streets. The project removed stormwater from the CSS and reduces the volume of combined flows to the future SCRTB. The existing combined sewers in the project area were converted to sanitary sewers to convey the sanitary flows downstream and remain connected to the combined sewer conveyance system. During the design of the project, it was noted that the rehabilitation need was not as extensive as anticipated, and Phase B, which was to address rehabilitation, was combined with Phase A, with all work accomplished in one project. Construction for the Aksarben Village Neighborhood Phases A and B project started on September 24, 2011. This project was complete on September 22, 2013.

Another important part of the project was a cost-saving measure that helped reduce community disturbance and added a green infrastructure element to an underutilized area of Elmwood Park. Storm sewers were constructed to carry stormwater northwest to Elmwood Park where it flows through a series of green infrastructure weirs and detention cells and is conveyed eventually to Elmwood Creek as shown on Figure 2-14.

FIGURE 2-14
Elmwood Park Green Infrastructure

Saddle Creek CSO 205 – 64th and Dupont Retention Treatment Basin (Under Construction)

The SCRTB is the final project in the Saddle Creek Basin. At the time of the 2014 LTCP Update, the City was preparing to bid a 315 MGD RTB, with 6.6-million-gallon (MG) storage volume. In August of 2015, a single bid was received for the SCRTB that was significantly over the engineer's estimate of $91 million. The City worked with the NDEE to modify the project's scheduled completion date to September 30, 2020 (later changed to December 31, 2023) in the CSO Permit. This allowed for the additional time necessary to re-evaluate the design of the project and provided a more realistic schedule for contractors to complete the work. A third-party VE study was completed to explore ways to reduce the cost of the project. The evaluation found that the project, as originally designed, would cost approximately $125 million, and the cost could not be significantly lowered. Thus, the City determined that a new configuration for the facility needed to be explored.

The City worked with the designer to review the project and develop alternatives that would comply with the United States Environmental Protection Agency (EPA) CSO Control Policy at a more affordable cost. An evaluation was performed of various alternatives, including different sizes of RTBs as well as replacement of the RTB with a storage tank. The City decided to move forward with a 160-MGD RTB with modifications so that it can disinfect flows up to 320 MGD (Figure 2-15). This involved the design of the headworks and disinfection system to handle 320 MGD, with a 3.3-MG basin. In this hybrid concept, the maximum treatment rate that is assumed to provide treatment equivalent to primary treatment is 160 MGD. Flow rates above 160 MGD, up to 320 MGD, may be allowed to enter the facility for short periods of time for disinfection to benefit water quality. However, wet weather volume capture is calculated based on the 160-MGD treatment rate. NDEE approved the hybrid concept for the RTB.

An evaluation was performed to determine how often flows would be between 160 and 320 MGD in the representative year. Table 2-3 shows that only 17 hours out of 290 hours of operation in the representative year would be above 160 MGD. Flows up to 320 MGD enter the basin only for short periods of time.

TABLE 2-3
Duration of Flows that Exceed 160 MGD

	Representative Year Duration (hr.)	**Percentage of Total Hours**
Duration of Filling Prior to Discharge	160	55%
Duration of Discharges up to 160 MGD	107	37%
Duration of Discharges above 160 MGD, up to 320 MGD	17	6%
Duration of CSO	6	2%
Total	**290**	**100%**

hr. = hour(s)

As part of the project, a new, larger diversion sewer is being constructed to convey dry-weather flows and a portion of wet weather flows to the Little Papillion Interceptor. The diversion includes gates to control the amount of flow diverted. When flows exceed downstream interceptor capacity, they will begin to fill the RTB. Until the basin fills, peak flow rates are equalized, and no discharge occurs. Some storms will generate small volumes of runoff that are less than the basin volume, so the RTB will not discharge and the captured volume will be dewatered to the PCWRRF. If the volume exceeds the basin capacity, then treated flows will overflow the effluent weirs and be discharged to Little Papillion Creek. The volume that remains in the basin after discharge stops will be dewatered to the interceptor and treated at PCWRRF. The RTB provides an underground structure where combined sewage undergoes grit and screenings removal, settling, chlorination, and dechlorination before discharge.

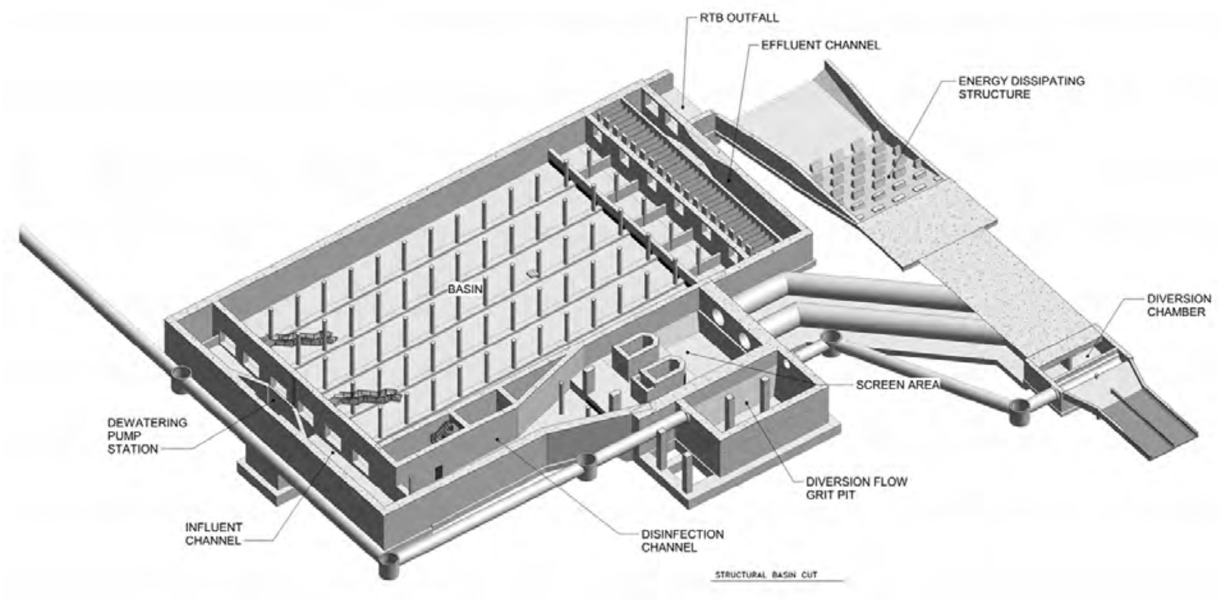

FIGURE 2-15
Saddle Creek Retention Treatment Basin Layout

Construction on the SCRTB began on April 30, 2019, and it is expected to be completed by December 2023. Figure 2-16 is a recent photo of the construction.

FIGURE 2-16
Construction of the SCRTB January 2021 (Courtesy of Multivista)

2.2.3.3 CSO 207 – 44th and Y Street and CSO 208 – 45th and T Street

42nd and Q Street Sewer Separation (Completed)

The project involved the construction of separate sanitary and storm flows in the CSO 207 and CSO 208 basins. New storm piping and bioretention ponds will carry flows from the areas upstream of CSO 207 directly to the outfall at Blood Creek. The Papillion Creek South CSO 207 diversion structure was reconstructed to a sanitary junction box and closed off from the storm system as part of the 42nd and Q Sewer Separation project (OPW 52257). The 42nd and Q Street sewer separation project involved reconstruction of the CSO 207 diversion structure so that it can no longer overflow to the waterway at 44th and T. The separated sanitary flows drain to the system that can overflow during wet weather at CSO 208 near 45th and Y Streets. The City has monitored the downstream CSO 208 diversion and determined that CSOs are still occurring occasionally. This drainage area will undergo a post-construction inflow and infiltration (I/I) study to determine if the basin has been completely separated. It is still the City's intent for the CSO 208 outfall to be deactivated as part of the CSO Program. Construction of the project started on May 1, 2018 and was completed on July 16, 2019.

As part of the 42nd and Q project, a green infrastructure component was constructed in Hitchcock Park (Figure 2-17). The project includes three interconnected ponds on the east side of the park that serve to capture and detain stormwater from both the east part of the park and the neighborhoods east of 42nd Street that drain into the area. Construction began on May 1, 2017 and was completed on October 6, 2017.

FIGURE 2-17
Hitchcock Park Green Infrastructure

2.2.3.4 CSO 209 – 44th and Harrison

42nd and X Sewer Separation Project (Completed)

The Papillion Creek South CSO 209 was closed as part of the 42nd Street and X Street Sewer Separation project (OPW 50986), which separated combined sewer flow in a portion of the Papillion Creek South Basin. Construction started on the project on May 13, 2010 and was completed on October 13, 2010. The outfall was evaluated and monitored for several years and permanently closed on September 27, 2012. The deactivation of CSO 209 means that Copper Creek no longer receives CSO flows.

2.2.3.5 CSO 210 – 72nd and Mayberry

Papillion Creek North (PCN) 210 Sewer Separation Project (Under Construction)

The purpose of the Papillion Creek North (PCN) 210 Sewer Separation Project (OPW 53320) is to allow the City to eliminate the CSO 210 diversion located at the intersection of 66th Street and Blondo Street. The project is to begin construction in 2021 with completion in 2022. Currently, the sewers upstream to the north and east of CSO 210 are combined sewers. A separate sanitary sewer extends downstream to the south of Blondo Street on North 66th Street. However, during the project study, a couple of inlets were found to be still draining to this system—a remnant of the earlier sewer separation program—and will be removed during the separation of this area.

The intent of the project is to separate the sanitary sewer flow and convey it to the existing sanitary sewer at North 66th Street and Blondo Street using the existing small pipe network and new pipes. The existing larger pipe network, along with new pipes will be used to convey the stormwater flow to 66th and Blondo Street allowing the stormwater flow to continue downstream to Little Papillion Creek at 72nd and Mayberry, in what is now the combined sewer outfall.

Following completion of the project, the City will develop and implement a flow monitoring program to determine the hydraulic performance of the separate sanitary sewer near and downstream of North 66th Street and Blondo Street. If the City can confirm through additional flow monitoring the risk of surcharging that could cause basement flooding does not exist, the new 12-inch interconnecting, or diversion, pipe can be filled and abandoned. The abandonment of the overflow diversion will be performed under the CSO Diversion Program, which has been added to the LTCP and is described in Sections 3 and 5.

2.2.3.6 CSO 211 – 69th and Pierce

CSO 211 Sewer Separation (Pacific Street from 63rd to 66th Streets) Project (Completed)

The CSO 211 Sewer Separation project (OPW 51686) included construction of a storm sewer along Pacific street between 63rd and 66th Streets. The project provided sewer separation for a portion of the Papillion Creek North Basin to reduce combined sewer flows to the CSO 211 diversion structure at South 66th and Pacific Streets. Construction started on July 8, 2013 and was completed on September 6, 2013. The CSO 211 diversion continues to be monitored for closure. However, a few inlets are still connected to the sanitary sewers in the CSO 211 basin that are planned to be separated during the adjacent sewer separation for CSO 212, which is currently under design. Further monitoring will be conducted after removal of the known inlets.

2.2.3.7 CSO 212 – 69th and Woolworth

CSO 212 – 64th Avenue and William Street (Under Design)

As described in the 2014 LTCP, the CSO 212 Sewer Separation project includes construction of storm sewer to provide sewer separation to the 41-acre area. The goal of the project is to provide adequate separation for the deactivation of the CSO 211 and 212 outfalls. This project is under design with construction anticipated to start in 2023 and be completed in 2025.

2.2.4 Cole Creek Watershed

Cole Creek Basin encompasses approximately 4,450 acres. Cole Creek itself is approximately 4 miles long and flows into Little Papillion Creek. The stream is on the 303(d) list for *E. coli* and dissolved oxygen (see Section 2.6.3, Total Maximum Daily Loads, for additional information). A total maximum daily load (TMDL) was developed in May 2009 for the Papillion Creek Basin and states, “There is insufficient data to determine the extent of water quality impact on Cole Creek from the combined sewer overflows (CSO)” (NDEE, 2009). The TMDL implementation plan is related to the management of stormwater discharges.

There are currently three CSO outfalls that discharge into Cole Creek: CSO 202, CSO 203, and CSO 204. The watershed and CSO outfalls are noted on Figure 2-18.

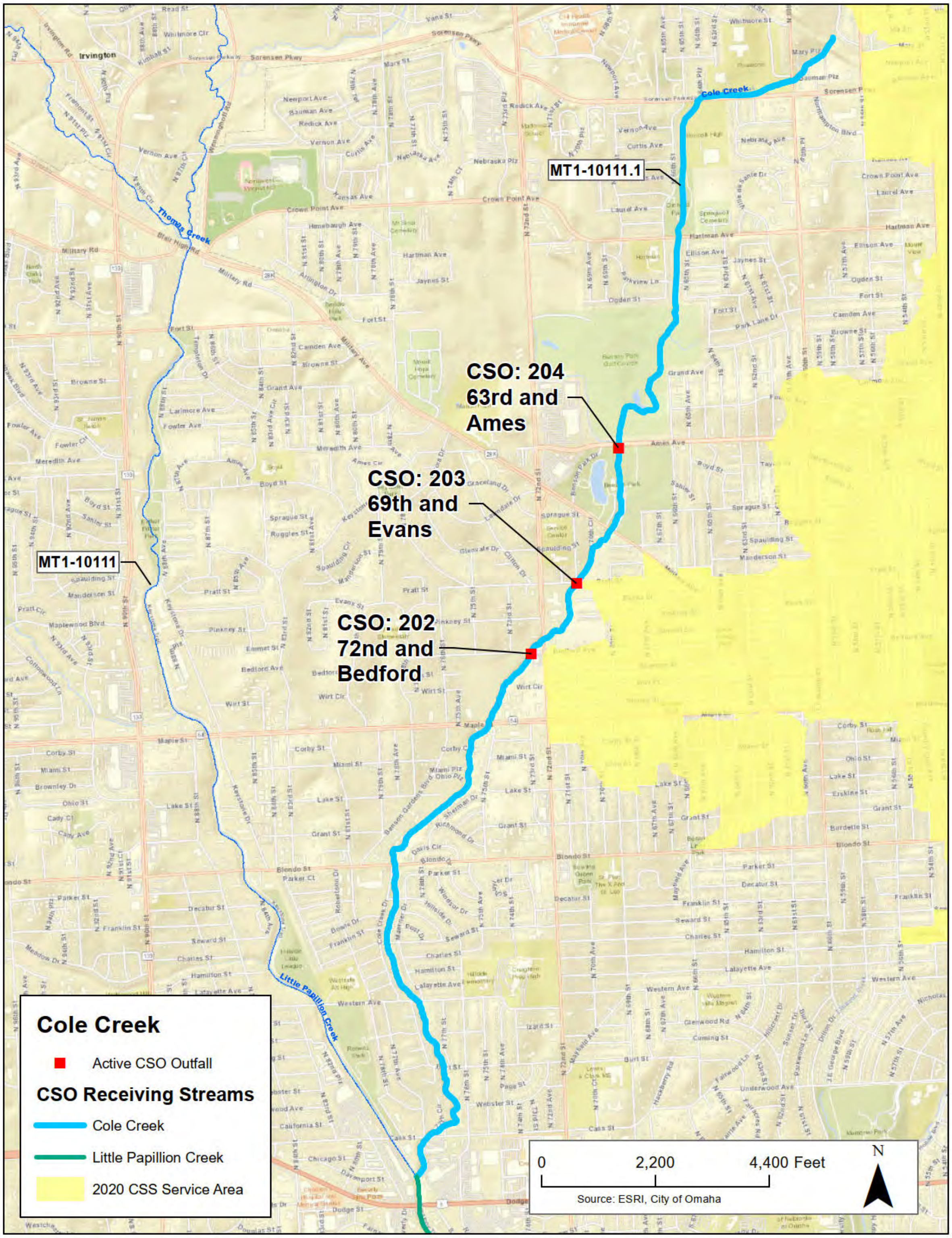

FIGURE 2-18
Cole Creek Watershed

2.2.4.1 CSO 202 – 72nd and Bedford

There are two projects in the CSO 202 area. The goal of these projects was to provide separation to an area bounded on the north by Bedford Avenue, on the east by 67th Avenue, on the south by Binney Street, and on the west by Cole Creek. The conceptual plan for this basin included the construction of both sanitary and storm sewer to allow for conversion of the existing combined sewer to either storm sewer or sanitary sewer, as appropriate, to provide sewer separation to this 101-acre sub-basin. In both the 2009 LTCP and the 2014 LTCP Update, the separation was to be accomplished in two phases. These are discussed in the following subsections. Monitoring will occur after the completion of the project to determine if the outfall can be deactivated.

CSO 202 Sewer Separation Phase 1 (Completed)

Cole Creek CSO 202 Sewer Separation Phase 1 (OPW 53417) included separation of a portion of the CSO 202 area constructed early to coordinate with construction of an adjacent City Transportation project at 72nd Street and Maple Street intersection. Construction began on September 7, 2019 and was completed on January 14, 2020.

CSO 202 Phase 2 – 70th Avenue and Spencer Street (Under Design)

The CSO 202 Phase 2 (OPW 53869) project includes separation of the majority of the CSO 202 area. This project is currently under design with construction anticipated to start in 2023 and be completed in 2027. Monitoring will occur after the completion of the project to determine when the outfall can be deactivated.

2.2.4.2 CSO 203 – 69th and Evans

Cole Creek CSO 203 Sewer Separation Project (Under Construction)

The CSO 203 project (OPW 53059) is a sewer separation project located in the Cole Creek Basin that will provide sewer separation through the construction of both sanitary and storm sewers. The project is anticipated to start construction in 2021 with completion anticipated in 2023. Monitoring will occur after the completion of the project to determine when the outfall can be deactivated.

2.2.4.3 CSO 204 – 63rd and Ames

The Cole Creek CSO 204 Sewer Separation project (OPW 51995) is a multi-phase project located in the Cole Creek Basin. The project covers a 522-acre area bordered on the north by Brown Street, on the east by 52nd Street, on the south by Northwest Radial Highway, and on the west by Cole Creek. A study was conducted for the entire area contributing to CSO 204. The City determined early in the preliminary design that an increase in the peak discharge of stormwater to Cole Creek would not be allowed by the City. The design of the CSO 204 area was modified from the conceptual plan in the 2009 LTCP, which called for new storm sewers sized for the 10-year design storm, to a design that would address sewer backups and localized street flooding without increasing the peak stormwater runoff from the area. This concept relies more on reuse of existing combined sewers converted to storm sewers. This change in concept, along with a determination that a portion of the area contributing to CSO 204 was already separated, allowed for the work schedule to be modified. The 2014 LTCP Update included six phases of work instead of the nine phases included in the 2009 LTCP. The first four phases included sewer separation, the fifth phase consisted of inflow reduction, and the sixth involved the construction of a storage tank. It is expected that CSO 204 will remain an active overflow after LTCP implementation is completed.

Cole Creek CSO 204 Area – Phase 1 Combined Sewer Separation (OPW 51995) (Completed)

This sewer separation project was the first phase of construction within the Cole Creek CSO 204 Basin and included construction of new sanitary sewers along 63rd Street between Taylor and Spaulding Streets, and in Benson Park north of the softball fields. Construction began August 10, 2015 and was completed on May 1, 2016. As part of the project, a new, temporary overflow was constructed from a diversion manhole to an existing 6-foot by 6-foot box to the CSO 204 Outfall. Following completion of the work in the CSO basin, the diversion is expected to be removed after monitoring verifies that it is not needed.

Cole Creek CSO 204 Sewer Separation Phase 2 (On Hold)

Cole Creek CSO 204 Sewer Separation Phase 2 (OPW 52814) includes a new sanitary sewer along 63rd Street from Spaulding to Bedford Streets connecting to the sanitary sewer built in Phase 1. The project was placed on indefinite hold in 2017 due to escalating construction costs and construction risk, as well as the social impact of displacing residents to carry out construction that would require demolition of homes. However, Phase 2 is not needed to achieve the 85 percent wet weather volume capture required by the CSO Program. The City/Program Management Team (PMT) continue to evaluate options. The potential replacement projects for CSO 204 Sewer Separation Phase 2 are discussed in Section 3 of this LTCP update.

Cole Creek CSO 204 Area - Phase 3 Combined Sewer Separation (Under Construction)

Cole Creek CSO 204 Phase 3 Combined Sewer Separation (Taylor to Ruggles Between 56th and 61st) (OPW 53206) includes a new sanitary sewer in Sprague Street to connect to a separated downstream sanitary sewer. Phase 3 is currently under construction and anticipated to be complete in 2022.

CSO 204 Phase 4 (Under Design)

CSO 204 Phase 4 sewer separation includes the extension of a separate sanitary and storm sewer to complete the separation in the system and other sanitary and storm sewer improvements. This project is expected to include removal of the Taylor CSO Diversion located west of the intersection of North 60th Street and Taylor Street, which is one of two CSO diversions in the CSO 204 area. This project will be conducted as two projects because of the amount of sewer separation needed (CSO 204 Phase 4a – 57th Street and Pratt Street and CSO 204 Phase 4b – 56th Street and Bedford Avenue). Field data is currently being collected prior to commencing preliminary design. It is anticipated that the first construction project will be completed in 2030 and the second in 2032.

2.3 Green Infrastructure Program

Green infrastructure is a way to use and mimic nature (topography, soil, and plants) to capture and filter stormwater by slowing it down, infiltrating it into the ground, and spreading it out through engineering or natural processes to manage stormwater near its source. The result is cleaner water, a healthier environment for all, potentially some reduction in CSO volume and frequency depending on the type and size of the project, and many other benefits beyond just managing stormwater.

The City's Green Infrastructure Program, established in 2007, is an integral element of the LTCP. It is not used specifically to achieve wet weather volume capture requirements, although it can and has helped contribute to captured volume. The primary goal of the City's Green Infrastructure Program is to cost-effectively implement green infrastructure to reduce the flow rate and volume of stormwater entering the CSS and thereby increase the service level of the CSS and reduce the cost of the CSO Program in addition to providing amenities to the public. Since the inception of the Program this has primarily been accomplished by implementing best management practices with LTCP projects. As part of every CSO project, a green infrastructure evaluation must be conducted to identify opportunities to incorporate green infrastructure. This has varied from small-scale water quality facilities to large-scale centralized stormwater management facilities that have been constructed to help reduce the size and cost of downstream infrastructure and provide amenities to the City and neighborhoods.

Green infrastructure evaluations have also been conducted at the watershed level to identify and evaluate potential specific green infrastructure projects. This evaluation was supported by a Site Suitability Analysis, which included a geographic information system (GIS)-based screening analysis of parcels within CSO areas to evaluate their suitability for green infrastructure. Based on criteria such as property ownership, soils, and slope properties were ranked to develop clusters of parcels that may be conducive for green infrastructure projects. Using this data and evaluating other constraints, specific green infrastructure projects were identified to help reduce CSO discharges. These green infrastructure projects included opportunities in City-owned parks at Field Club Trail, Hanscom Park, Kountze Park, Schroeder-Vogel Park, and Turner Boulevard. To date, the Hanscom Park project and the Vinton project (which is a part of Field Club Trail) have been designed and constructed.

As part of the Green Infrastructure Program, other tasks and activities have been developed or monitored. These activities include the following:

- Updated the CSO Green Infrastructure Guidance document, which provides guidance to consultants on implementation of green infrastructure in sewer separation and facility projects.
- Collaborated with the City's Municipal Separate Stormwater Sewer System (MS4) program to ensure green infrastructure maintenance requirements and responsibilities are established and tracked.
- Improved City's CSS InfoWorks model and City's GIS data to improve stormwater and green infrastructure modeling and determination of CSO benefits.
- Conducted peer review of CSO cities to establish an understanding of how green infrastructure is implemented and funded.
- Developed a Vacant Lot or Abandoned Property Program Review to gather information from selected CSO cities that have abandoned property strategies. The review provided a snapshot of each program and how managing vacant lots contributes to their stormwater management goals.

As the LTCP matures and adapts to changing conditions, so too has the Green Infrastructure Program. In Section 5.3.2 Green Infrastructure Program, the updated tools and strategies that have been evaluated, some of which have been recommended but not yet implemented, to help implement stormwater management into the future are discussed. These potential strategies include implementing programmatic initiatives and utilizing tools and incentives that will allow the City to opportunistically take advantage of development, redevelopment, and other construction activities in the CSS area to cost-effectively reduce CSOs.

2.4 Other Programs

The City has developed a Master Plan for their two WRRFs: MRWRRF and PCWRRF. The purpose of the Master Plan is to identify near- and long-term facility improvements to meet current and future effluent limits, treat future wastewater flows and loadings, and meet appropriate condition and reliability requirements. A 5-year Capital Improvements Plan (CIP) for near-term facility improvements has been developed, in addition to a long-term 20-year schedule.

The Master Plan impacts the CSO Program in the following ways:

- The Master Plan has evaluated the impacts of wet weather flows on the two facilities. At the MRWRRF, this includes the treatment of 64 MGD of flow through secondary treatment and disinfection. Recent improvements to the facility under the CSO Program provide for a wet weather treatment capacity of 150 MGD through preliminary and primary treatment and disinfection, and 64 MGD through secondary treatment. Future process changes must accommodate these flows, including dewatering flows from future CSO facilities in the collection system. The Master Plan has also evaluated wet weather treatment capacity for the PCWRRF for possible expansion of its wet weather flow capacity, which directly affects CSO 201.
- Site requirements for new treatment facilities will impact the ability to locate any future CSO facilities at the space-limited MRWRRF. The City will need to coordinate efforts to meet the needs of both the CSO Program and Wastewater Master Plan to establish efficient and cost-effective approaches.
- The significant cost of WRRF improvements and required schedules may affect the implementation schedule of the CSO Program. The City has balanced the needs of CSO, the WRRFs, and other costs associated with the City's collection and treatment system. The results are reflected in the 2021 LTCP Update.

2.5 Collection System Model Overview

A computer model representing the hydrologic and hydraulic elements of Omaha's combined and sanitary sewer system was created using InfoWorks software to support the development of the 2009 LTCP. Since the original model was completed in 2004 (prior to the official start of the LTCP development effort), several cycles of updating, calibrating, and extending the model have been undertaken to update the model with sewer system changes, improvements to the model's representation of the sewer system (for example, by adding detail or replacing assumptions with new data), and to prepare it to be used for a wider range of evaluations to aid effective implementation of the LTCP. Interim models are sometimes developed to evaluate progress at specific points in time. The 2009 LTCP provides more detail about the development of the model. This section provides a brief overview of the model but primarily summarizes updates to the model after the 2014 LTCP Update submittal.

The comprehensive model is organized into three model elements.

- A **hydrologic runoff** model to simulate wet weather flows (storm runoff that enters the sewer system) in the combined, separate sanitary, and storm sewer systems.
- A **dry-weather flow** model to simulate sanitary inflows from residential, commercial, and industrial users and groundwater infiltration.
- A **hydraulic collection system** model to simulate the routing of the runoff and inflow from the previous two model elements within the sewers.

The first two of these elements address the three inflow components of the model: base sanitary flow, groundwater infiltration, and runoff.

Approximately 330 square miles of land area are included in the model. About 36 square miles are modeled as combined sewer contributing drainage areas (as of 2020), while the rest is modeled as separate sanitary sewer area. The service area is modeled in over 12,000 subareas called subcatchments. This level of detail facilitates distinguishing between areas with different runoff characteristics. The most challenging aspect of modeling Omaha's hydrology is that the sewer system ranges from separate sanitary to combined, and thus the amount of runoff entering the sewer system differs significantly among areas. This facet of the sewer system was captured using contributing area. During calibration, flow monitoring data were used to help determine how much of the land area in each subcatchment is contributing runoff into the sewer.

Because updates have occurred in many cycles, reference to the model versions can be confusing. In general, there are three main versions of the model as follows:

- One representing the sewer system in 2002 coinciding with the City's first CSO Permit (called *Existing Conditions Model* or *2002 Existing Conditions Model*)
- One approximately representing the current sewer system (necessary for some evaluations and for use with new flow monitoring data; *Current Model*)
- One representing the future sewer system after implementation of the LTCP (*LTCP Model;* the name sometimes includes a future date to distinguish between the LTCP Model used for the 2009 LTCP submittal [*2024 Model*], the LTCP Model used for the 2014 LTCP Update [*2027 Model*], and the LTCP Model used for this 2021 LTCP Update [*2037 Model*]).

When a project is constructed, its details go into the Current and LTCP Models. When an assumption is replaced by a field measurement, the change may be needed in all the models. If the text refers simply to "the model," it is in a context in which it is not necessary to be specific as to which database was used.

2.5.1 Model Expansion

Since the 2014 LTCP Update, a significant expansion of the model was completed in specific areas of the sewer system where more complex CSO projects are planned, to provide more detailed information in the upstream areas of the watersheds/sewersheds. This added detail better allows for the evaluation of the effectiveness of green infrastructure and stormwater control measures at specific locations up in the system. The model, when originally built, focused on detailed information and calibration at the CSO outfalls and included information on pipes with diameters of 24 inches and larger. The updated model includes pipes with diameters of 12 inches and larger in the focus areas. The updated model better supports decisions about CSO controls and provides more reliable information on the impacts in the CSO basins where combined and storm sewer systems are operating side-by-side. Major changes included the following:

- Upgrades to the level of detail in the Burt-Izard, Minne Lusa, Leavenworth, South Interceptor, Ohern/Monroe, Cole Creek, and Saddle Creek basins were completed.
- The standard minimum pipe diameter was decreased to 12 inches, more than doubling the number of modeled pipes. Modeled pipe length increased from 450 to 800 miles.
- Subcatchment areas were reduced and the number of subcatchments was greatly increased—from 1,000 to 12,000—to match the increased detail in the pipe network.
- Storm and sanitary subcatchments were modeled separately in the combined sewer focus areas. Storm subcatchment boundaries follow topography, and sanitary subcatchments match census areas.
- Separate storm sewers were modeled in the areas where additional detail was added (Burt-Izard, Minne Lusa, Leavenworth, South Interceptor, Ohern/Monroe, Cole Creek, and Saddle Creek Basins).
- Industrial and commercial flows were modeled separately based on water use data. About a dozen large users were previously modeled separately; the updated model includes thousands of separate inputs for these flows, which helps increase the accuracy of the spatial distribution of sewer flows.
- Infiltration was modeled separately based on pipe length and diameter instead of being included in the population-based sanitary flow rate.
- Base sanitary flow rates were updated with the latest long-term average WRRF flow rates.
- Planimetric data acquired by the City in 2013 were used in the updated model to determine impervious areas. The improved accuracy resulted in some flow shifting among the CSO outfalls, although the overall CSO volume estimated by the model is about the same. This result shows the importance of obtaining the planimetric data and adding a significant level of detail to the model.

Table 2-4 provides a comparison of the number of modeled elements among the LTCP models used for the 2009, 2014, and 2021 LTCPs.

TABLE 2-4
Comparison of Model Elements Included in LTCP Models

Model Element	2009 LTCP	2014 LTCP Update	2021 LTCP Update	Notes
Nodes	5,681	8,131	22,039	Includes manholes, blind connections, wet wells, and other structures
Pipes	6,479	9,019	21,287	Length of pipe: 416 miles (2009), 449 miles (2014), 834 miles (2021)
Subcatchments	1,010	1,181	12,427	
Weirs	40	37	142	
Orifices	20	26	53	
Sluice Gates	45	75	132	
Pumps	30	37	62	Number with variable frequency drives (VFDs) modeled: 0 (2009), 21 (2014), 27 (2021)
Bar Screens	11	16	38	
Flap Gates	22	28	41	Prevent river intrusion into sewer system or limit to one-way flow inside the sewer system

2.5.1.1 Model Calibration and Flow Monitoring

Data are collected to assess and calibrate the model. This section describes flow and rainfall monitoring and the storm events that were selected to use in model calibration.

Flow and Rain Monitoring

The City has invested in flow and rain monitoring since the start of development of the CSS model in 2003. This has included the installation of over 500 flow meters as a part of both temporary and permanent efforts to characterize the flows in the system. Early efforts included temporary programs to characterize the system at the CSO outfalls and diversion structures and at complex interconnection points within the system, and a collaboration effort with the United States Geological Survey (USGS) on a water quality study to support the development of the LTCP. During development and implementation of the LTCP, additional monitoring programs have been conducted within the basins and again at outfalls, diversion structures, and complex areas of the system where additional information was needed, as well as after construction of CSO projects to evaluate project effectiveness and gather information for the model. Radar/rainfall information has been used since the beginning of model development to provide more accuracy on the spatial variation of storms.

Recent efforts include large temporary monitoring efforts in 2016, 2017, 2018, and 2019, as well as ongoing monitoring of the City's permanent monitoring locations. Figure 2-19 shows rain and flow monitoring locations in the CSS, with recent locations highlighted.

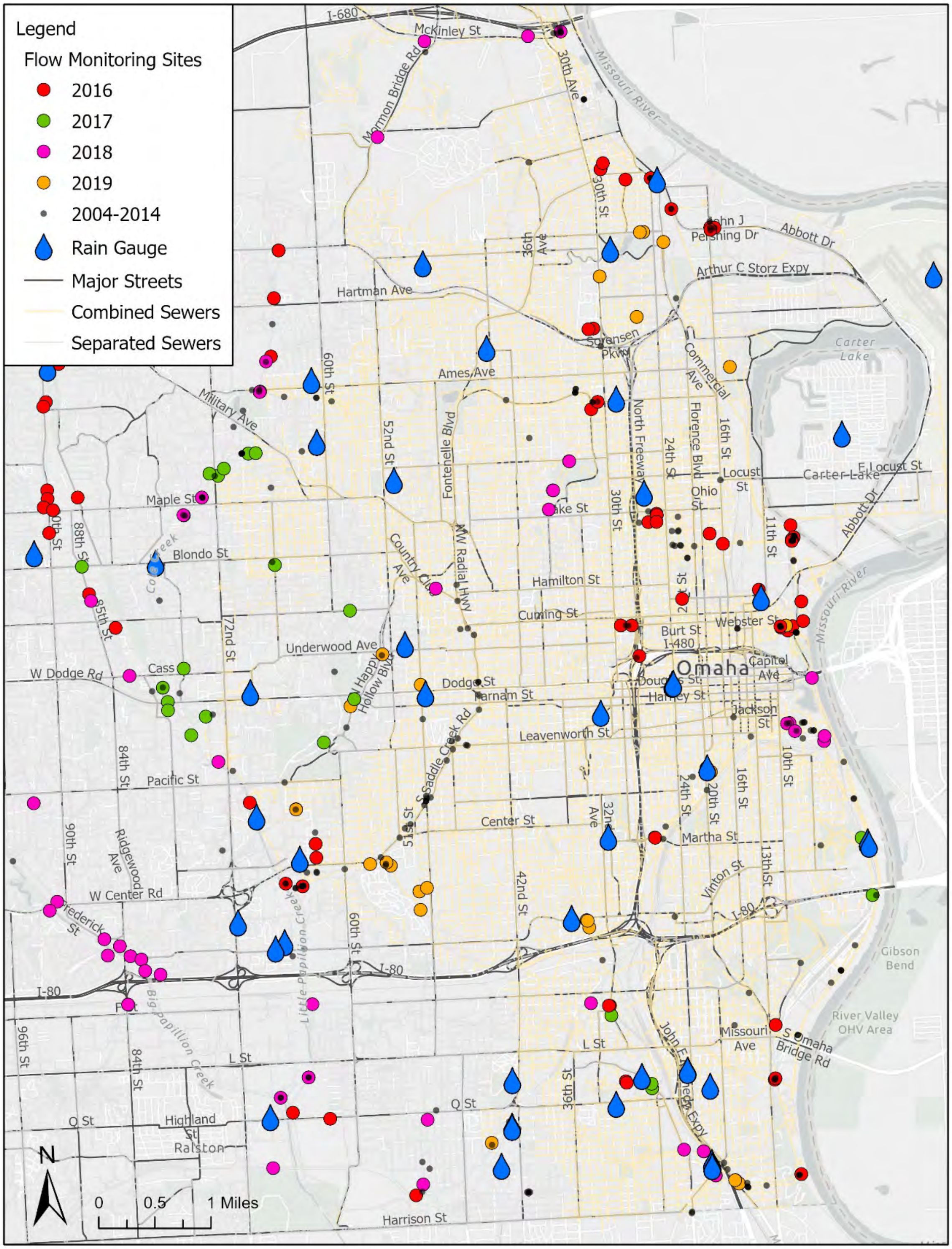

FIGURE 2-19
Rain and Flow Monitoring Locations in the Combined Sewer System

Calibration Storms

The storm events from the 2016, 2018, and 2019 monitoring seasons used for calibration represent a wide range of storm events—with low and high volumes, low and high intensities, short and long durations—because the model is used to simulate multiple years of precipitation data and it is essential that it be able to reproduce results from different types of storm events.

Figure 2-20 shows the 2016, 2018, and 2019 storm events plotted with similar data from the representative year. The figure shows that the range of storms within the representative year matches well with the range of calibration storms, indicating that the model is calibrated for the correct scale of rainfall.

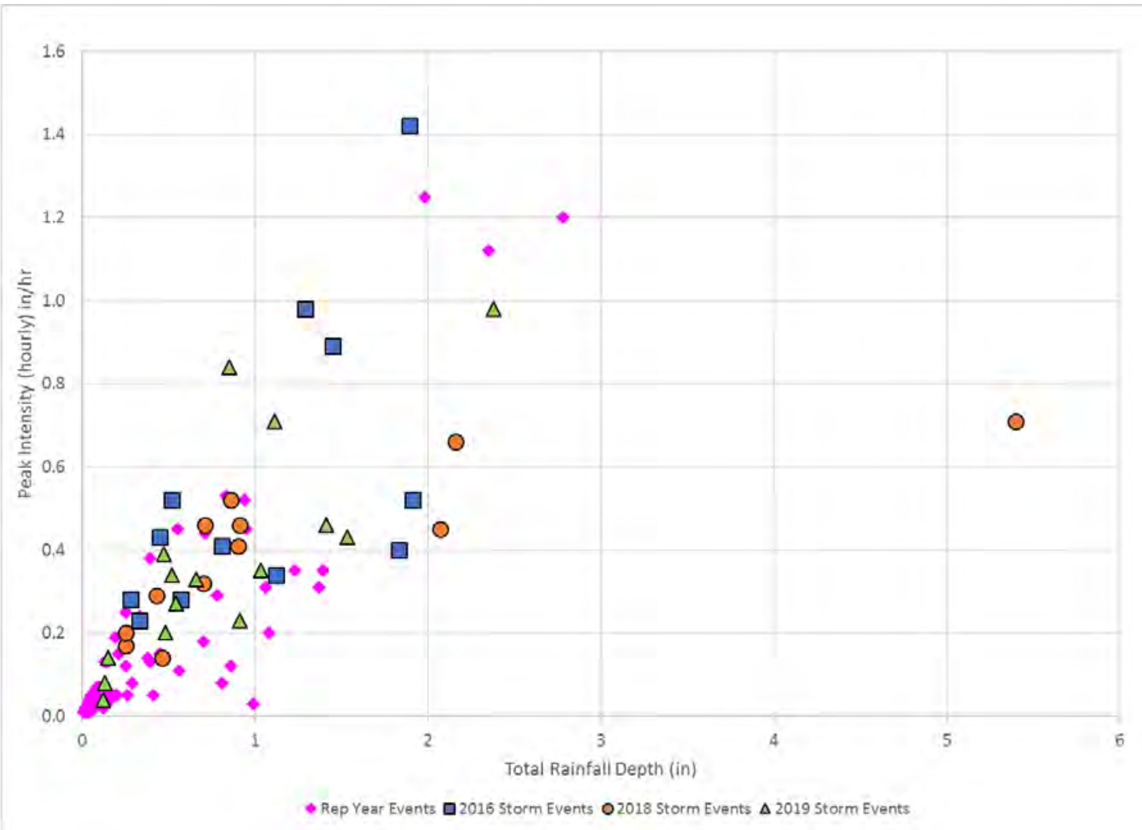

FIGURE 2-20
Comparison of Storm Events from Recent Flow Monitoring Data and Representative Year

Model Calibration

The expanded model was recalibrated using recent flow and rain data as well as older data that are still representative. The additional detail in the model and the recalibration resulted in some shifting of the flows among the CSO outfall areas, although the overall volume stayed about the same. Figures 2-21 and 2-22 show examples of calibration graphs used to assess how well the model is calibrated at a given location.

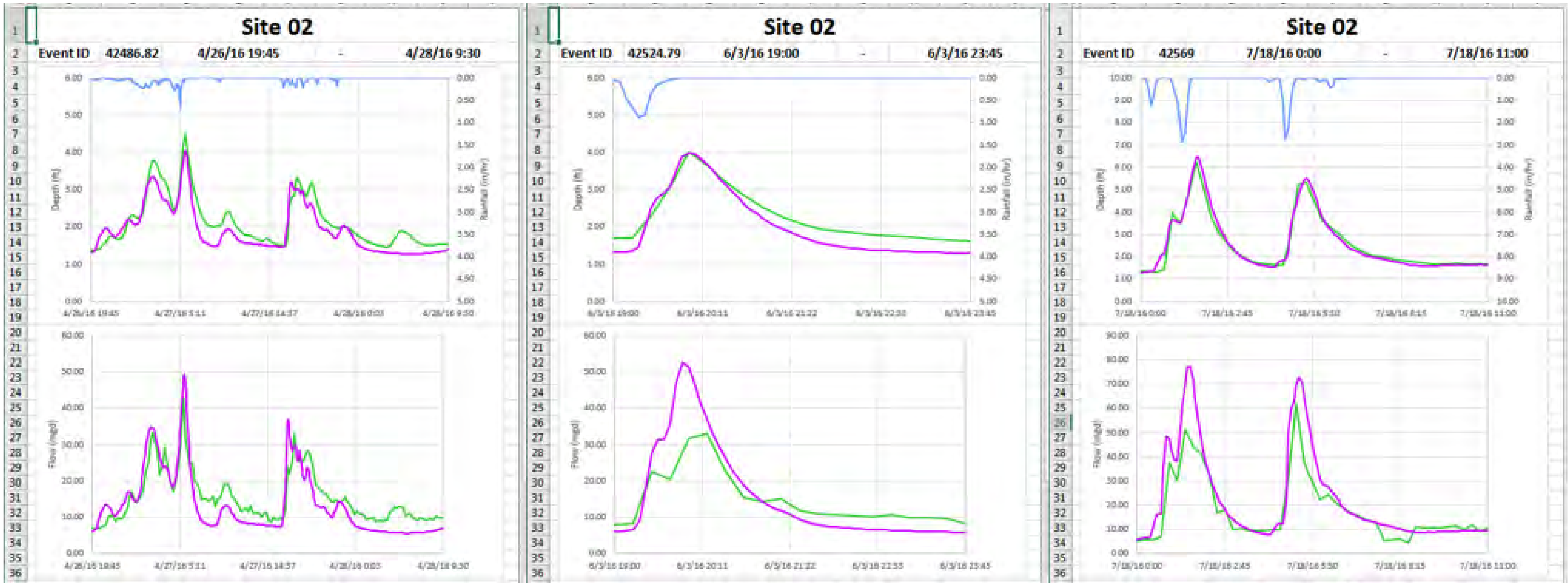

FIGURE 2-21
Example Calibration Hydrographs at Minne Lusa Diversion for Three Storms (meter = green, model = purple)

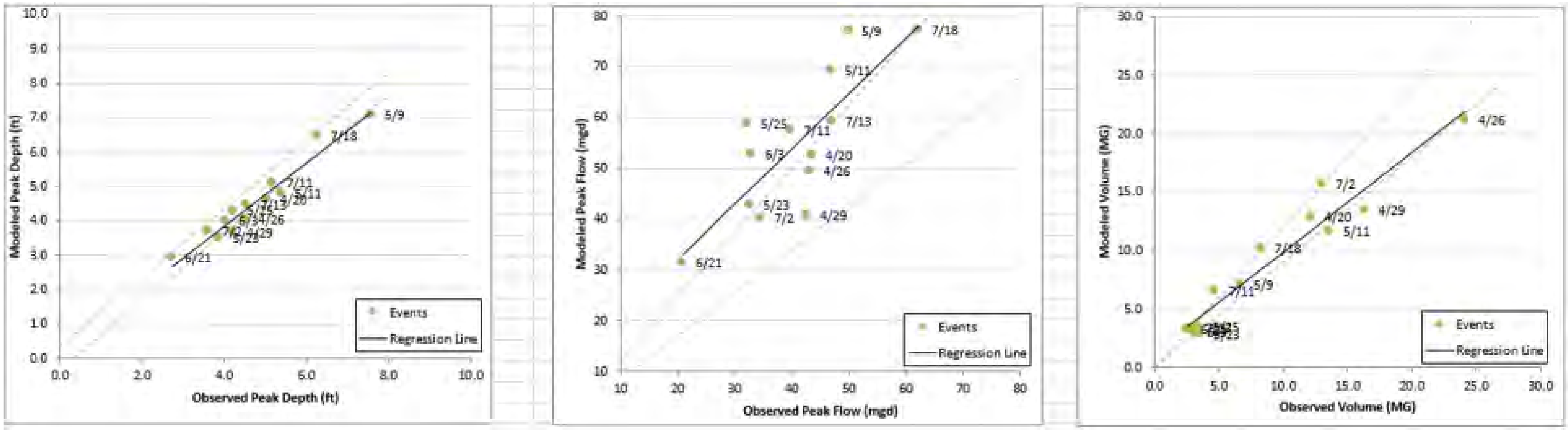

FIGURE 2-22
Example Calibration Scatterplots at Minne Lusa Diversion for 2016 Calibration Storms
(left = peak depth, middle = peak flow rate, right = volume; dotted lines show recommended calibration boundaries)

2.5.1.2 Outfall Summary – Frequency, Duration and Magnitude for the Representative Year Precipitation with Existing (2002) Conditions

Table 2-5 presents a summary of the frequency, magnitude, and peak flow rate of CSOs associated with each outfall under sewer system conditions as of the year 2002, which for the purposes of the LTCP is considered "Existing Conditions," because it corresponds with the date of the City's first CSO Permit. The frequency ranges from 3 to 86 CSO occurrences in the MRW and from 0 to 64 CSO occurrences in the PCW. The total CSO volume for the representative year under existing conditions was estimated to be 2,878 MG for the MRW and 777 MG for the PCW.

TABLE 2-5
Estimated CSO Frequencies, Volumes, and Peak Flow Rates for the Representative Year Precipitation under Existing Conditions[b]

Location	CSO Outfall Number	CSO Frequency (number per year)	Annual CSO Volume (MG)	CSO Peak 15-Minute Rate (MGD)
MRWRRF Primary Clarifier[d]	102	81	283.7	70.6
Bridge Street Lift Station	103	6	0.3	2.4
Mormon Street	104	13	4.4	26.0
Minne Lusa Avenue	105	86	472.0	720.3
North Interceptor	106	67	431.0	145.3
Grace Street	107	64	214.0	264.0
Burt-Izard Street	108	43	407.1	616.1
1st and Leavenworth	109	54	490.7	460.7
Pierce Street Lift Station	110	28	5.6	17.3
Hickory Street Lift Station	111	3	0.1	1.8
Martha Street	112	20	6.1	22.0
Spring Street Lift Station	113	3	0.1	1.0
Grover Street	114	38	7.8	15.9
Riverview Lift Station	115	37	47.4	95.6
Homer Street	116	22	2.7	10.0
Missouri Avenue	117	37	30.3	64.1
South Omaha - Ohern Street	118	35	197.9	420.7
Monroe Street Lift Station	119	86	238.2[c]	420.6[c]
Jones Street	121	14	38.3	198.2
Total for Missouri River Watershed		**86**	**2877.8**[d]	
PCWRRF Interceptor	201	8	28.1	36.8
72nd and Bedford	202	41	15.3	28.4
69th and Evans	203	27	3.9	12.9
63rd and Ames	204	64	68.7	148.4

TABLE 2-5
Estimated CSO Frequencies, Volumes, and Peak Flow Rates for the Representative Year Precipitation under Existing Conditions[b]

Location	CSO Outfall Number	CSO Frequency (number per year)	Annual CSO Volume (MG)	CSO Peak 15-Minute Rate (MGD)
64th and Dupont	205	64	652.9	1537.6
43rd and S Street[e]	206	0	0.0	0.0
44th and Y Street	207	18	4.9	17.2
45th and T Street	208	3	0.1	0.8
44th and Harrison[a]	209	0	0.0	0.0
72nd and Mayberry	210	15	3.3	14.1
69th and Pierce	211	16	0.1	0.6
69th and Woolworth[a]	212	0	0.0	0.0
Total for Papillion Creek Watershed		**64**	**777.4**	

Notes:
[a] No flow from this outfall is predicted for the representative year under 2002 Existing Conditions.
[b] Data from 2002 Existing Conditions (2019v3r24) InfoWorks Models.
[c] Total for North and South Barrels.
[d] CSO 102 – MRWRRF Primary Clarifier is a bypass rather than a CSO; however, it is included in this table because it is listed in the City's CSO Permit.
[e] CSO 206 was separated prior to 2002.

2.6 Water Quality and Water Quality Model Update

This section updates the relevant information that was included in the 2009 LTCP and the 2014 LTCP Update. It also provides information on the water quality model developed for the Missouri River and Cole Creek.

2.6.1 Changes to Designated Uses and Standards of the Receiving Streams

In the 2009 LTCP, it was noted that there were five streams in the Omaha area that receive CSO discharges during wet weather events. With the deactivation of CSO 209, Copper Creek no longer receives CSO flows. This has reduced the number of streams impacted by CSOs to four. The Missouri River receives direct runoff from the portion of the City defined within the MRW (the other streams are within the PCW and are tributaries to Papillion Creek). The streams receive runoff directly from that portion of the City tributary to the specific stream. As noted previously, runoff from the PCW eventually enters the Missouri River by way of Papillion Creek.

The following are the four streams, listed by watershed, that receive CSOs:

MRW

- Missouri River (currently 17 CSOs)

PCW

- Cole Creek (currently three CSOs)
- Little Papillion Creek (currently four CSOs)
- Blood Creek (currently one CSO)

The NDEE's designated water quality uses for these water bodies are presented in Table 2-6. The segment numbers are illustrated on Figures 2-23 and 2-24. Figure 2-24 also shows the locations of the four streams listed above, in relation to the CSOs and the CSS service area. The classifications have not changed since development of the LTCP in 2009.

TABLE 2-6
Beneficial Use Classifications for Streams Adopted by NDEE

Segment Name	Segment Number	Segment Description	NDEE Beneficial Uses
Missouri River	MT1-10000	Missouri River – Big Sioux River to Platte River	Recreation Warmwater Aquatic Life Class A Public Drinking Water Agricultural Class A Industrial Aesthetics
Papillion Creek	MT1-10100	Bib Papillion Creek to Missouri River	Recreation Warmwater Aquatic Life Class A Public Drinking Water Agricultural Class A Aesthetics
Big Papillion Creek	MT1-10110	Big Papillion Creek – Little Papillion Creek to Papillion Creek	Recreation Warmwater Aquatic Life Class A Agricultural Class A Aesthetics
Little Papillion Creek	MT1-10111	Little Papillion Creek – Thomas Creek to Big Papillion Creek	Recreation Warmwater Aquatic Life Class B Agricultural Class A Aesthetics
Cole Creek	MT1-10111.1	Entire length	Recreation Warmwater Aquatic Life Class B Agricultural Class A Aesthetics

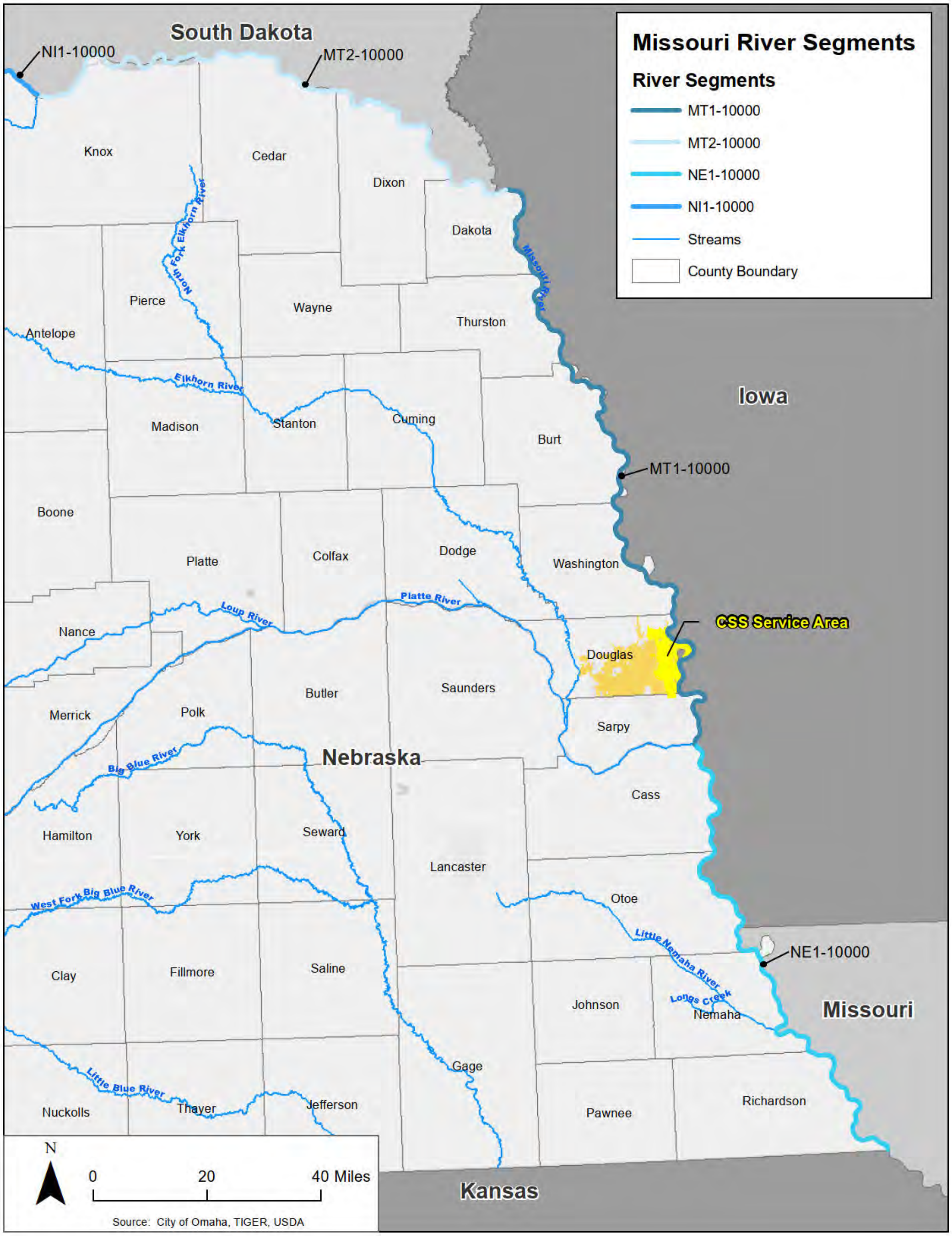

FIGURE 2-23
Missouri River Stream Segments Established by NDEE and CSS Service Area

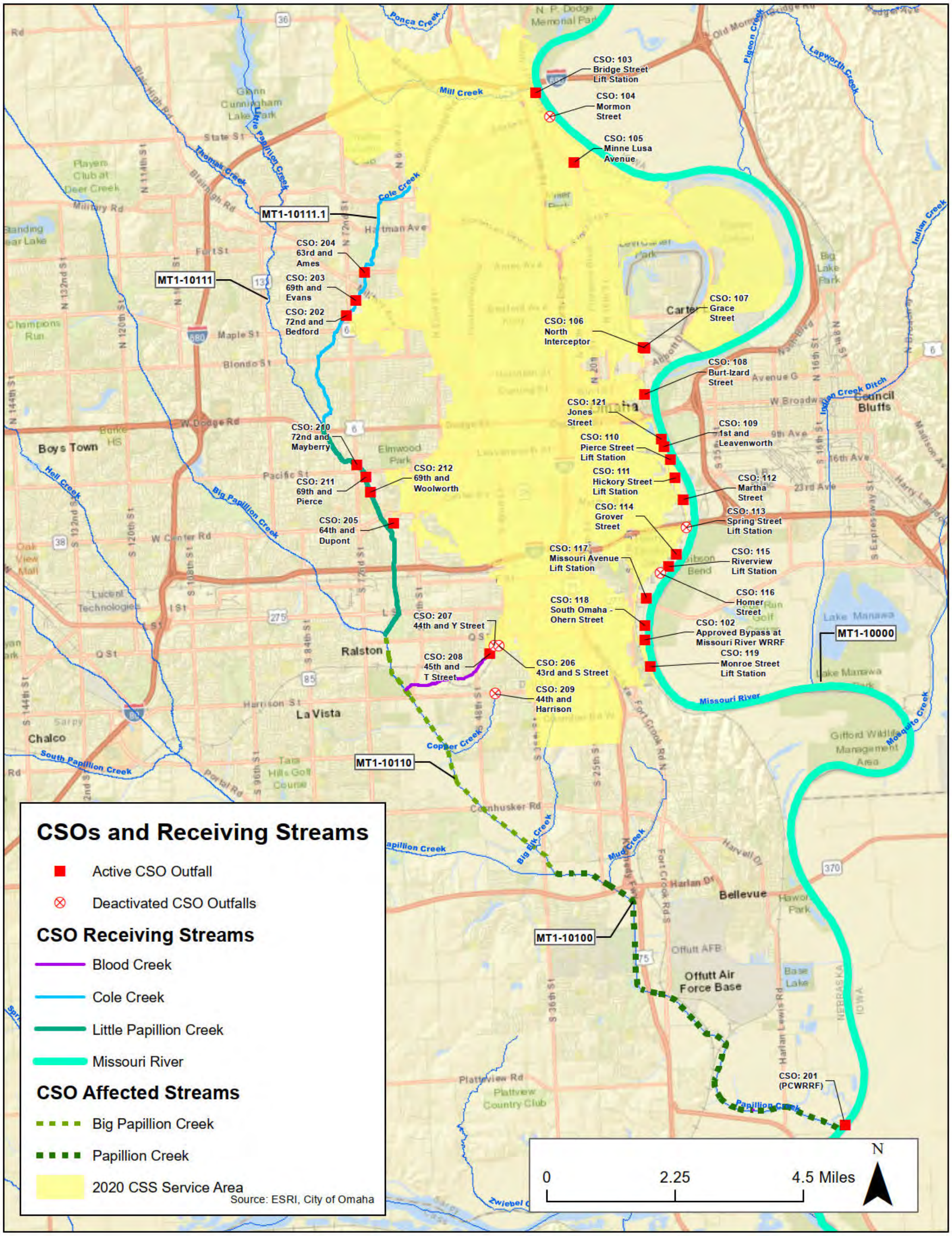

FIGURE 2-24
Stream Segments Established by NDEE in the Omaha Area

The standards that protect the uses listed in Table 2-6 are included in Nebraska Administrative Code, NDEE, Title 117 – Nebraska Surface Water Quality Standards, Chapter 4 (Title 117), June 24, 2019 (NDEE, 2019).

Title 117 also has established several “Key Species.” These species are those identified as endangered, threatened, sensitive, or recreationally important aquatic species. They are associated with the various water bodies and their aquatic life use classes. Title 117 lists the species for both the Missouri River Segment 10000 and Papillion Creek Segment 10100. The “Key Species” in the Missouri River are shown in Table 2-7.

TABLE 2-7
Key Species

Classification	Missouri River (MT1-10000) Species	Papillion Creek (MT1-10100) Species
Endangered Species	Pallid sturgeon	*Pallid sturgeon*
	Sturgeon chub	*Sturgeon chub*
Threatened Species	Lake sturgeon	*Lake sturgeon*
Sensitive Species	*American Eel*	*American Eel*
	Black Buffalo	*Black Buffalo*
	Blue Catfish	*Blue Sucker*
	Blue Sucker	*Bluntnose Minnow*
	Bluntnose Minnow	*Burbot*
	Burbot	*Channel Catfish*
	Channel Catfish	*Flathead chub*
	Flat Floater	*Flathead Catfish*
	Flathead Catfish	*Plains Minnow*
	Flathead chub	*Sicklefin chub*
	Paddlefish	*Tadpole madtom*
	Plains Minnow	*Western silvery minnow*
	Sicklefin chub	
	Tadpole madtom	
	Western silvery minnow	
	Yellow sandshell	

Note:

Species added to the list since 2014 are in italics.

The Title 117 list of Key Species was significantly modified in 2019 and the revisions are noted in Table 2-7. The result was that several species were removed from the list and several others added. Another major change was the inclusion of Key Species for Papillion Creek Segment MT1-10100. The only major change was to include the pallid sturgeon and sturgeon chub on Papillion Creek.

2.6.2 Description of the Monitoring Programs

Figure 2-25 shows the monitoring points that the City monitors along with the CSO outfalls.

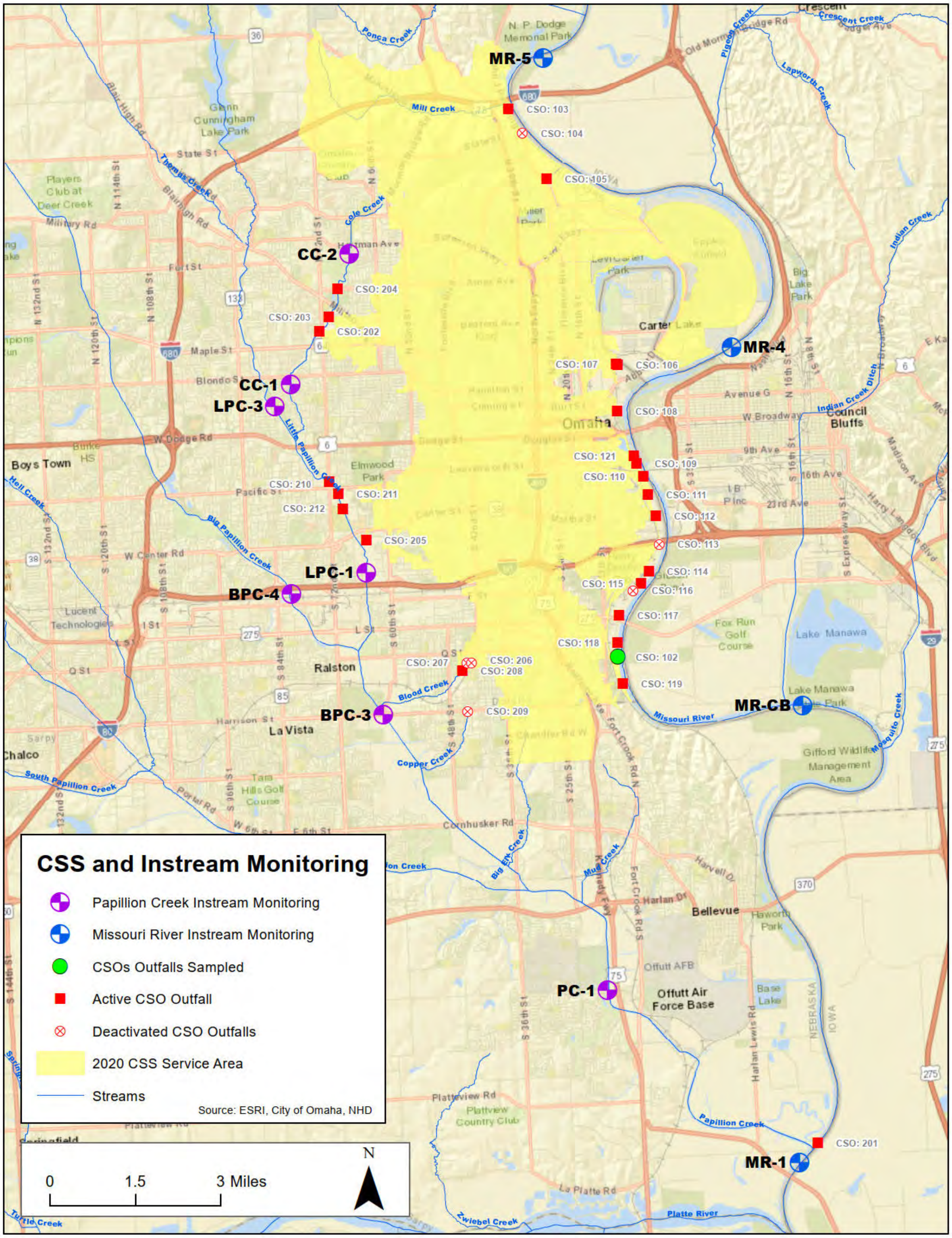

FIGURE 2-25
Missouri River and Papillion Creek Monitoring Locations

United States Geological Survey

Since 2012, the USGS Nebraska Water Science Center has been conducting a Missouri River water quality monitoring program at selected points in the Missouri River. Figure 2-26 shows a picture sample collection by the USGS.) The following are the goals of the monitoring program:

- Provide continuous stage and discharge records for the Missouri River at locations important to the pursuit of understanding the water quality in the river.
- Provide continuous monitoring of selected water quality parameters at such locations.
- Provide monthly discrete water quality sampling of selected compounds at such locations.

The USGS scope of work operates continuous monitoring water quality probes at four sites along the Missouri River. These sites are as follows, from upstream to downstream:

- MR-5: USGS Site Number: 412126095565201 - Missouri River at NP Dodge Park (above the City)
- MR-4: USGS Site Number: 411636095535401- Missouri River at Freedom Park (below the Airport)
- MR-CB: USGS Site Number: 06610505- Missouri River near Council Bluffs, Iowa (below MRWRRF and above the confluence with Papillion Creek, north/east side of the river)
- MR-1: USGS Site Number: 410333095530101 - Missouri River near La Platte (downstream of the PCWRRF and below the confluence with Papillion Creek but above the Platte River)

FIGURE 2-26
USGS Collecting Sample in the Missouri River (Courtesy of Matt Moser, USGS)

The USGS has been performing monthly sampling events beginning in July 2012 at the four Missouri River sites as well as collection of samples during wet weather events (Figure 2-27). Parameters obtained during monthly sampling include the following:

- Discharge
- pH
- Temperature
- Dissolved oxygen
- Specific conductance
- Turbidity
- E. coli and total coliform
- Total suspended solids (TSS)
- Total phosphorous (colorimetric)
- Biochemical oxygen demand 5-day (BOD5)
- Total Kjeldahl Nitrogen (TKN)
- Nitrogen, nitrate
- Nitrogen-ammonia (liquid)
- Floating debris

These data are available on the USGS website. Table 2-8 summarizes the data over the 3 years. The data show that while the other parameters are consistent from upstream to downstream, the *E. coli* levels increase as it goes downstream.

TABLE 2-8
USGS Data Summary (2018 to 2020)

	Monitoring Site (Upstream to Downstream)							
	MR-5 NP Dodge		MR-4 Freedom Park		MR-CB Council Bluffs		MR-1 La Platte	
Parameter	Max	Min	Max	Min	Max	Min	Max	Min
Discharge (cfs)	101,000	34,000	98,300	34,600	103,000	35,300	96,500	35,300
Temperature (ºC)	28.7	0	27.7	0.6	28.2	0	28.6	0
Dissolved Oxygen (mg/L)	14.2	5.9	13.1	6.7	14.1	6.2	14.1	5.8
BOD_5 (mg/L)	4	2	3	2	3	2	6	2
pH	8.7	7.9	8.5	8.1	8.5	7.9	8.4	7.9
TSS (mg/L)	1,170	37	280	29	196	39	233	15

TABLE 2-8
USGS Data Summary (2018 to 2020)

Parameter	Monitoring Site (Upstream to Downstream)							
	MR-5 NP Dodge		MR-4 Freedom Park		MR-CB Council Bluffs		MR-1 La Platte	
	Max	Min	Max	Min	Max	Min	Max	Min
E. coli (cfu/100 mL)	>2,400	15	2,400	5	7,700	5	>2,400	5
Total Coliform (MPN/100 mL)	>24,000	210	>24,000	550	>24,000	550	>24,000	2,400

Notes:

Data presented are provisional unless otherwise noted.

°C = degree(s) Celsius

cfs = cubic feet per second

mL = milliliter(s)

MPN = most probable number

City Sampling Data

In addition to the USGS sampling, the City performs sampling of the Papillion Creek tributaries at various points. These data are provided in the CSO annual reports provided to NDEE to summarize the CSO Program for each year. Table 2-9 provides a summary of the *E. coli* data that were collected from 2018 to 2020.

TABLE 2-9
E. Coli Sample Results of the Papillion Creek Tributaries

Monitoring Point	Description	Median	Geometric Mean	Minimum	Maximum
Dry Weather					
CC-1 (Cole Creek)	Downstream of CSO discharge points	592	686	90	7300
CC-2 (Cole Creek)	Upstream of CSO discharge points	1492	1118	90	4000
LPC-1 (Little Papillion Creek)	Downstream of CSO discharges and upstream of confluence with Big Papillion Creek	192	257	50	1414
LPC-3 (Little Papillion Creek)	Upstream of the confluence with Cole Creek (upstream of CSOs)	380	487	80	12400
BPC-3 (Big Papillion Creek)	Downstream of the confluence with Little Papillion Creek and respective CSOs	665	830	360	2900
BPC-4 (Big Papillion Creek)	Upstream of the confluence with Little Papillion Creek (upstream of CSOs)	600	474	40	1553

TABLE 2-9
E. Coli Sample Results of the Papillion Creek Tributaries

Monitoring Point	Description	Median	Geometric Mean	Minimum	Maximum
PC-1 (Papillion Creek)	Downstream of the confluence with Big Papillion Creek and all respective CSOs	390	367	210	600
WET WEATHER					
CC-1 (Cole Creek)	Downstream of CSO discharge points	8100	10922	2200	84000
CC-2 (Cole Creek)	Upstream of CSO discharge points	10800	7483	1414	26800
LPC-1 (Little Papillion Creek)	Downstream of CSO discharges and upstream of confluence with Big Papillion Creek	7300	8292	2420	26100
LPC-3 (Little Papillion Creek)	Upstream of the confluence with Cole Creek (upstream of CSOs)	4300	5362	2300	16000
BPC-3 (Big Papillion Creek)	Downstream of the confluence with Little Papillion Creek and respective CSOs	14900	9705	2420	30000
BPC-4 (Big Papillion Creek)	Upstream of the confluence with Little Papillion Creek (upstream of CSOs)	6600	6776	2420	31000
PC-1 (Papillion Creek)	Downstream of the confluence with Big Papillion Creek and all respective CSOs	2420	4870	1120	25000
ALL DATA					
CC-1 (Cole Creek)	Downstream of CSO discharge points	2420	2736	90	84000
CC-2 (Cole Creek)	Upstream of CSO discharge points	2660	2893	90	26800
LPC-1 (Little Papillion Creek)	Downstream of CSO discharges and upstream of confluence with Big Papillion Creek	1917	1461	50	26100
LPC-3 (Little Papillion Creek)	Upstream of the confluence with Cole Creek (upstream of CSOs)	2420	1616	80	16000
BPC-3 (Big Papillion Creek)	Downstream of the confluence with Little Papillion Creek and respective CSOs	2720	3120	360	30000
BPC-4 (Big Papillion Creek)	Upstream of the confluence with Little Papillion Creek (upstream of CSOs)	1987	1793	40	31000
PC-1 (Papillion Creek)	Downstream of the confluence with Big Papillion Creek and all respective CSOs	1120	1477	210	25000

The data suggest that the Papillion Creek tributaries do not comply with the water quality standard of a geometric mean of 126 coliform units per 100 milliliters (cfu/100 mL) during dry weather as well as wet weather. However, there appears to be some degradation during wet weather.

2.6.3 Total Maximum Daily Loads

Every 2 years, NDEE evaluates the streams in Nebraska and decides whether they are exceeding the state's water quality standards. A list of the segments that exceed the standards is then developed. This list is known as the 303(d) List, referencing the section of the Clean Water Act (CWA) that requires the list to be developed. These lists are included in what is referred to as the "Water Quality Integrated Report." Table 2-10 lists the Missouri River and PCW segments described above and whether they were listed in the 2008 Water Quality Integrated Report (NDEQ, 2008) which was reflected in the 2009 LTCP, the 2014 Water Quality Integrated Report (NDEQ, 2014) or the 2020 Water Quality Integrated Report (NDEE, 2020). The NDEE's listing criteria uses all data available through its sampling as well as sampling performed by others and does not differentiate between samples collected during wet weather (when there is precipitation) and dry weather.

TABLE 2-10
303(d) List Status of Streams in the CSO Area

Segment	Description	Listed in 2008 NDEE Report?	Listed in 2014 NDEE Report?	Listed in 2020 NDEE Report	Parameters of Concern for LTCP Update
Missouri River – Nebraska-South Dakota border (Sec 21-35N-10W) to Niobrara River	NI1 – 10000	No	No	Yes	Fish Consumption Advisory for Mercury
Missouri River – Niobrara River to Big Sioux River	MT2 – 10000	No	No	Yes	Public Water Supply – Sulfate
Missouri River – Big Sioux River to Platte River (this segment flows past the City of Omaha)	MT1 – 10000	Yes	No	Yes	Public Water Supply – Sulfate, Arsenic Recreation – *E. coli*,
Missouri River – Platte River to Nebraska-Kansas border (Sec 32-1N-19E)	NE1 – 10000	Yes	Yes	Yes	Recreation – *E. coli* Fish Consumption Advisory for Mercury
Papillion Creek	MT1-10100	Yes	Yes	Yes	Recreation – *E. coli* TMDL Approved 9/09 (Selenium removed)
Big Papillion Creek	MT1-10110	Yes	Yes	Yes	Recreation – *E. coli* TMDL Approved 9/09
Blood Creek	Not designated	N/A	N/A	N/A	None
Little Papillion Creek	MT1-10111	Yes	Yes	Yes	Recreation – *E. coli* TMDL Approved 9/09

TABLE 2-10
303(d) List Status of Streams in the CSO Area

Segment	Description	Listed in 2008 NDEE Report?	Listed in 2014 NDEE Report?	Listed in 2020 NDEE Report	Parameters of Concern for LTCP Update
Cole Creek	MT1-10111.1	Yes	Yes	Yes	Recreation – *E. coli* TMDL Approved 9/09 Aquatic Life - dissolved oxygen
Hitchcock Park Lake	MT1-L0040	No	Yes	Yes	Aquatic Life use impaired for pH; Total phosphorus and total nitrogen not assessed
Hanscom Park Lake	MT1-L0060	No	No	No	
Fontenelle Park Lake	MT1-L0070	No	No	No	Insufficient data to determine if beneficial uses are met
Miller Park Lake	MT1-L0110	No	Yes	Yes	Aquatic Life use impaired for pH. Total phosphorus and total nitrogen not assessed

The changes from the 2014 LTCP include listing of the Missouri River for exceedance of sulfate, which is a public water supply-based standard that is not related to CSOs. In addition, the Missouri River Segment MT1-10000 is again listed for *E. coli*, whereas it was not in 2008 or 2014. This is the segment to which the CSOs discharge. Over the years this segment has gone back and forth between being listed and not listed for *E. coli*.

2.6.4 Water Quality Model

Since development of the 2009 LTCP, the City has used a water quality model to evaluate the possible impact that the CSO controls would have on the Missouri River and the Papillion Creek tributaries. A spreadsheet model has been used. This section discusses the new models developed for the 2021 LTCP Update.

2.6.4.1 Missouri River Water Quality Model

A water quality model that simulates *E. coli* was built to encompass the Missouri River from NP Dodge Park located on the north side of Omaha to a location downstream near the confluence with Platte River, approximately 32 river miles. The water quality model uses a more advanced approach than the previous LTCP spreadsheet model. The purpose of the improved water quality model is to predict the presence of *E. coli* more accurately within the Missouri River near Omaha, and to better understand the impacts from the City's CSS.

The water quality model includes all potential key sources of *E. coli* to the river within that portion of the river, including *E. coli* that enters the river from: upstream of NP Dodge Park, all City CSO and stormwater outfalls that discharge to Missouri River, both City WRRFs, Papillion Creek, Council Bluffs Wastewater Treatment Plant, and three streams in Iowa (Pigeon Creek, Mosquito Creek, Indian Creek) that flow into the Missouri River. Figure 2-27 shows the upstream and downstream boundaries of the model.

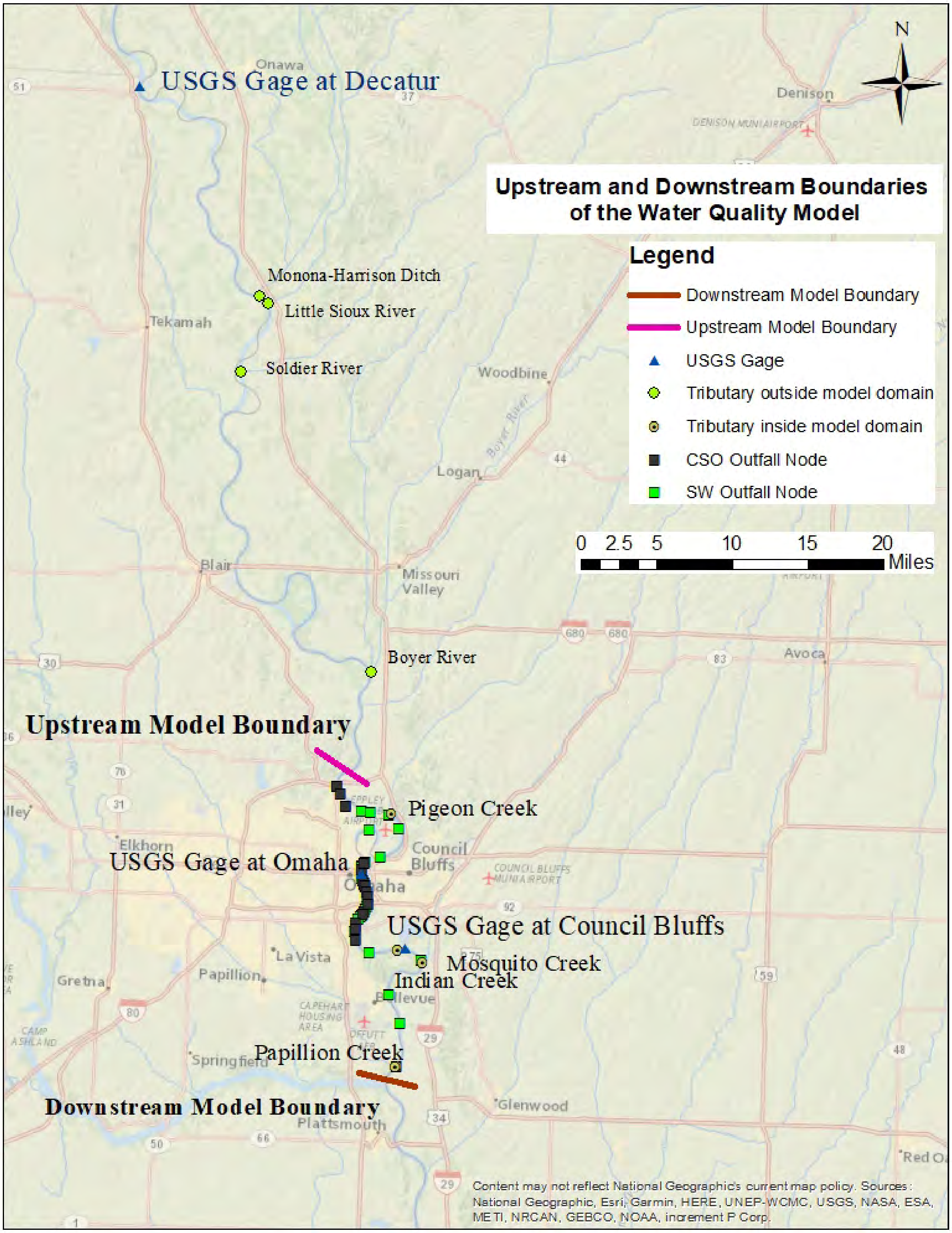

FIGURE 2-27
Boundaries of the Missouri River Water Quality Model

The selected water quality modeling approach applies InfoWorks ICM to simulate the in-stream fate and transport of *E. coli* that is contributed from point and nonpoint sources (where the latter are captured implicitly through tributary concentrations), and the dynamic changes in *E. coli* concentrations during wet and dry-weather periods. In contrast with the previous LTCP spreadsheet model, the InfoWorks ICM water quality model performs sub-daily calculations with in-stream decay at a finer spatial resolution.

A one-dimensional (1D)[2] surface water hydraulic model was developed to provide the time-varying volumes, depths, and velocities throughout the model extent. A model using the United States Army Corps of Engineers (USACE) Hydrologic Engineering Center's River Analysis System (HEC-RAS) software that was applied in the Missouri River Floodway Study (USACE 2007) was obtained from the USACE Omaha District, and was imported to InfoWorks ICM. Model nodes were then added in InfoWorks ICM to represent the CSO, stormwater, WRRF, and tributary discharge points that were not included in the HEC-RAS model.

Flows at the upper model boundary at NP Dodge Park were based on USGS discharge data from gage stations at Decatur and tributaries between Decatur and NP Dodge Park. Flows from City WRRFs were based on daily observed data; flows from CSO and stormwater outfalls were based on City collection system model output; flows from Papillion Creek were based on USGS gaged data; flows from Council Bluffs Wastewater Treatment Plant were based on reported average values; and flows from the three Iowa streams were based on Boyer River gaged discharge with drainage area adjustment.

The river hydraulic model was successfully calibrated and validated against USGS discharge and stage data from Missouri River gage stations near I-480 and Council Bluffs, respectively (Figure 2-28). The model reliably simulated discharges of 65,000 cfs or less, which is suitable for bacteria modeling that reflect representative year conditions.

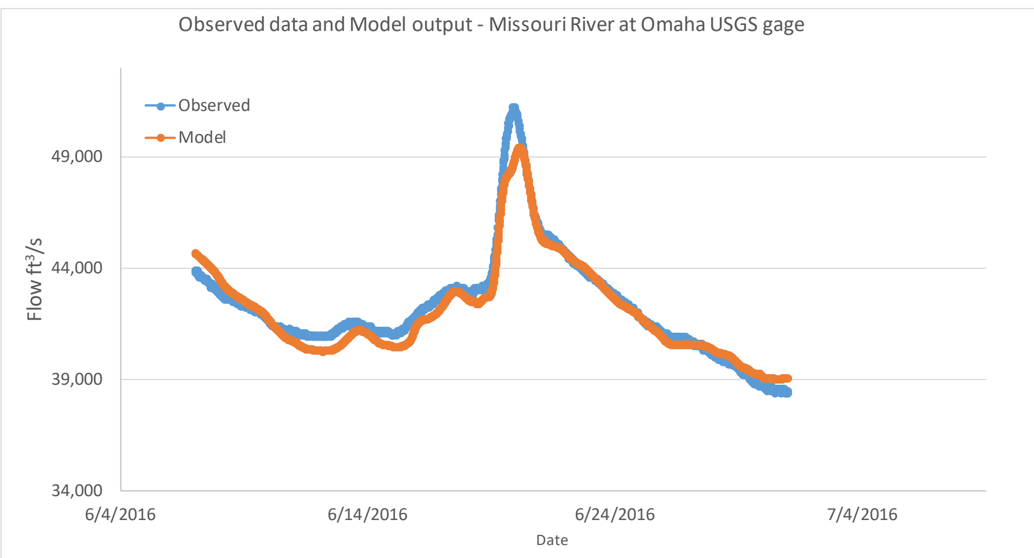

FIGURE 2-28
Example of calibration of the river hydraulic model

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2 In 1D models, a model cell extends across the entire river width and water column; the simulated concentration varies longitudinally along the river, but not laterally or vertically. This approach is often applied for rivers and streams that are well mixed, cross-channel, and throughout the water column.

A 1D water quality model was then developed through applying data collected by the City and USGS to represent the typical input concentrations contributed by each of the source categories mentioned above. In particular, the 2006-2007 USGS study provided a valuable dataset, as well as ongoing sampling in Missouri River and Papillion Creek, and National Pollutant Discharge Elimination System (NPDES) sampling of CSO and WRRF discharge concentrations.

The water quality model includes the natural process of decay that occurs to *E. coli* as it is transported downstream, represented with a first-order decay rate that accounts for in-stream water temperature. Decay occurs faster at warmer water temperatures, and more slowly at cooler water temperatures.

A sensitivity analysis was performed on a range of decay rate and input source concentrations. A conservative first-order decay rate safely within the range of reference values (0.5 per day at 20°C) was selected based on comparison of model output to observed data. The most sensitive input was CSO concentration, which was set to 420,000 cfu/100 mL, based on the median value of 147 local measurements; it yielded a conservative set of model output that sufficiently matched observed in-stream data, whereas higher CSO concentrations were found to be overly conservative in their model output predictions.

Following the sensitivity analysis, the water quality model was successfully calibrated against in-stream data (collected at Freedom Park, Council Bluffs, above confluence with Platte River) during six wet weather events between 2007 and 2017 that represent a range of recreation season conditions.

Section 5 provides a summary of the results of the water quality modeling of the final proposed CSO controls. Appendix C includes additional detail on the development of the Missouri River Water Quality model.

2.6.4.2 Papillion Creek Watershed Model

The spreadsheet water quality model was used for the evaluation of the CSO discharges into the various Papillion Creek tributaries. Modifications to the spreadsheet included the following:

- Used 2017 HEC-HMS model from Papio-Missouri River Natural Resources District (PMRNRD) study to develop runoff timeseries based on 1969 rainfall data.
- Added baseflows in each of the Papillion Creek tributaries based on available USGS streamflow data. HEC-HMS flows were ground-truthed by comparing to USGS streamflow history at available gages.
- Based upstream concentrations on available water quality data.
- Updated wet/dry recreation season median *E. coli* concentrations based on existing data. Also used lower concentrations associated with the TMDL, as noted below.
- Applied stormwater outfall and CSO concentrations that were used in Missouri River ICM model previously discussed.
- Also used the *E. coli* values in the NDEE TMDL for Papillion Creek in the evaluation to ensure that the remaining CSOs do not preclude the stream's meeting water quality standards.

2.7 Sensitive Areas Description

The City has updated the original evaluation regarding the presence of sensitive areas, as defined by the EPA CSO Control Policy, within the vicinity and downstream of CSO discharges (Figure 2-29). Copies of Sensitive Area Letters to and from Agencies are included in Appendix A. This was done to comply with Part V.C. - Consideration of Sensitive Areas as required in the CSO Permit. The requirement states that “The City of Omaha shall include any changes to the status of previously identified sensitive areas in the Annual Report By October 1, 2014, the City must submit a report to the NDEQ on reassessment of overflows to sensitive areas in those cases where elimination or relocation of the overflow is not included in the 2009 LTCP. The reassessment shall be based on consideration of new or improved techniques to eliminate or relocate overflows or changed circumstances that influence economic achievability.”

The EPA CSO Policy and other EPA guidance for sensitive use areas were revisited for the 2021 LTCP Update. Sensitive use areas include the following:

- Public Drinking Water Intakes
- Swimming beaches designated as such by the appropriate state or local health department or another agency
- Waters with existence of threatened or endangered species, or their designated critical habitat, specifically the pallid sturgeon

The EPA CSO Control Policy also requires the identification of Outstanding National Resource Waters, National Marine Sanctuaries, and shellfish beds. At the time of the 2021 LTCP Update, as was found at the time of the 2014 LTCP update and the 2009 LTCP, none of these three types of waters is found in the Omaha area. Further detail is provided below.

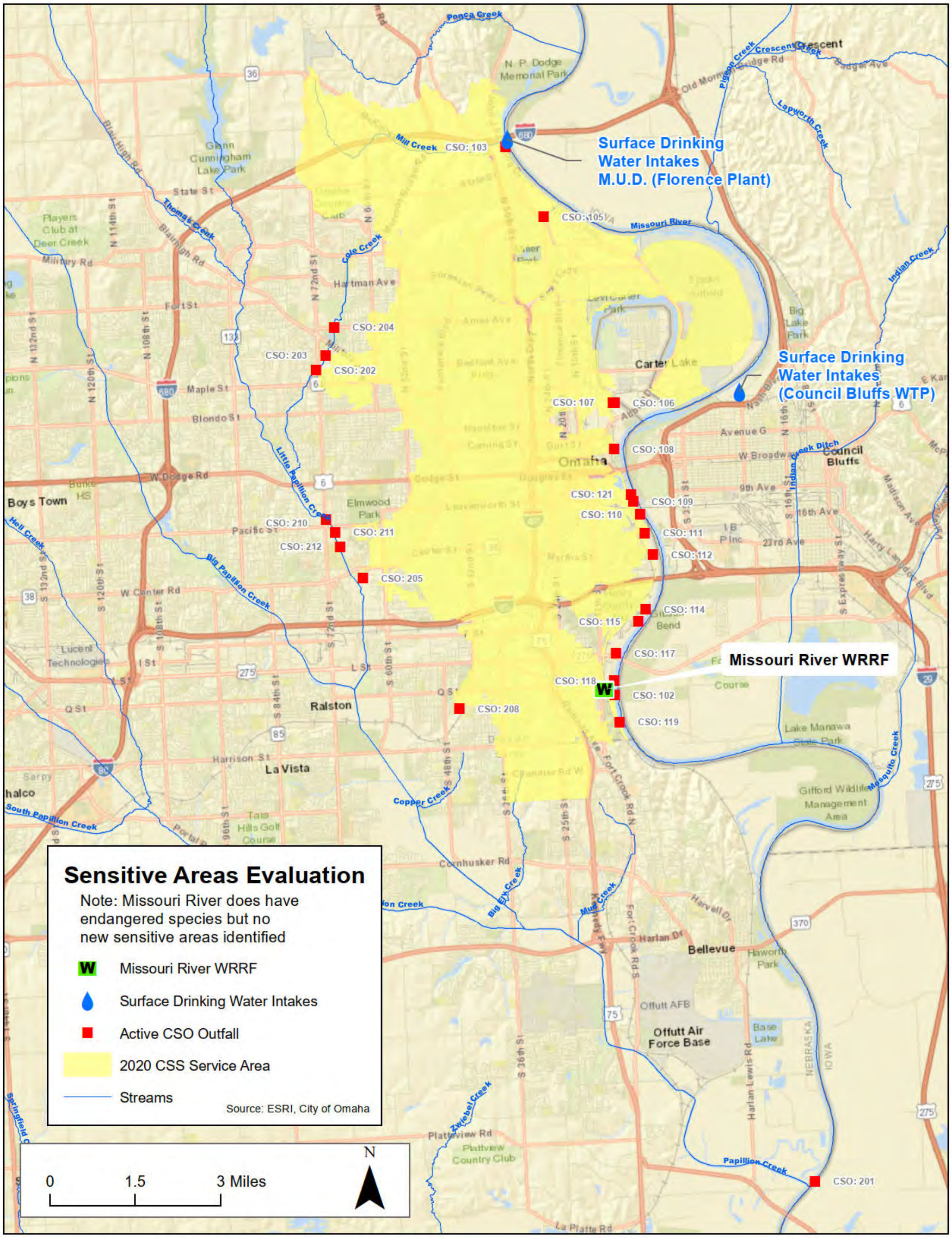

FIGURE 2-29
Sensitive Areas Analysis

2.7.1 Public Drinking Water Intakes Update

Appropriate Nebraska and Iowa agencies were again contacted. It was determined that there are no new drinking water intakes in the vicinity or downstream of Omaha's CSOs. As part of the 2014 LTCP Update sensitive areas analysis, follow-up correspondence was sent to the Nebraska Department of Health and Human Services to confirm there are no new surface water intakes on the Nebraska side of the Missouri River downstream of the Metropolitan Utilities District (M.U.D.) Florence Water Treatment Plant. The M.U.D. Florence Water Treatment Plant is on the Missouri River upstream of the CSO outfalls as shown on Figure 2-29. There are still no drinking water intakes on Papillion Creek or its tributaries. Again, in the 2021 LTCP Update, follow-up correspondence was sent to the Nebraska Department of Health and Human Services, and they confirmed that there are no new drinking water intakes since the 2014 LTCP Update.

According to the Iowa Department of Environmental Quality, the City of Council Bluffs has a surface water intake in the Missouri River located near the Council Bluffs Water Treatment Plant, on the north side of Council Bluffs and south of Eppley Airfield along the east side of the River as shown on Figure 2-29. At the time of the 2014 LTCP Update and sensitive areas analysis, follow-up correspondence was sent to the Iowa Department of Public Health to confirm there are no new public drinking water intakes on the Iowa side of the Missouri River. This was also confirmed in 2021.

CSO 105 – Minne Lusa Avenue is the only CSO outfall that regularly discharges to the Missouri River above the Council Bluffs intake.

In addition to domestic surface water supplies, an evaluation was done to determine if there are drinking water wells under the influence of surface water in Nebraska. It was determined that there are several groundwater wells south of the City along the Missouri River, but these wells are for industrial or irrigation uses and not for a domestic supply. Therefore, their use should not be affected by the CSO discharges.

At the time of development of the 2009 LTCP, Nebraska City had a groundwater well that was influenced by the Missouri River, but it was not a direct intake from the river. As part of the 2014 and 2021 LTCP Updates and sensitive areas analyses, the locations and types of registered groundwater wells in the Omaha area were reviewed using the Nebraska Department of Natural Resources (NDNR) online geospatial interface, to confirm there are no new active domestic wells in areas impacted by CSOs.

One of the CSOs located above the Council Bluffs intake (CSO 103 – Bridge Street Lift Station) does not regularly discharge and is anticipated to be deactivated by 2026, and the other CSO (CSO 104 – Mormon Street) has been deactivated, meaning it was closed off by block and mortar and cannot overflow, since the 2014 LTCP Update. As noted in the 2009 LTCP, and in the 2014 LTCP Update, although the Council Bluffs intake is located downstream of CSO 105 – Minne Lusa Avenue, an impact to the Council Bluffs Water Treatment Plant intake water quality is unlikely. It is probable as a result of the large Missouri River flow velocity, low CSO discharge velocity, and relatively small CSO volume (as compared to Missouri River flows) that the CSO impacts do not extend across the Missouri River to the eastern shoreline and impact the drinking water intake.

Initially the City had planned on the construction of the first phase of a storage tank for CSO 105 early in the Program. However, through additional study of the Minne Lusa Basin it became uncertain whether a tank would be the most cost-effective solution for addressing the discharges from this CSO. The additional controls for this CSO were part of the Optimization Evaluation that is discussed in Section 3 and summarized in Section 5.

2.7.2 Recreational Uses Update

At the time of development of the 2009 LTCP, and the 2014 LTCP Update, no designated swimming beaches along the Missouri River or Papillion Creek and its tributaries existed. This is primarily the result of barge traffic on the Missouri River that is not conducive to supporting designated swimming beaches during the summer season. Beaches are not encouraged on rivers that are open for navigation because the large commercial vessels would endanger swimmers.

As part of updating the LTCP and sensitive areas analysis, updated aerial photographs of these recreation areas were evaluated to confirm that there were no new swimming beach areas. Based on this review, it was concluded that there are no swimming beaches located within the vicinity or downstream of the CSO outfalls. There are no designated swimming beaches within the Missouri River or Papillion Creek Drainages.

2.7.3 Threatened or Endangered Species

To reconfirm the existence of federal- or state-listed threatened or endangered species that would be impacted by CSO discharges, as part of this LTCP Update, the Nebraska Game and Parks Commission and the United States Fish and Wildlife Service were again contacted. Appendix D includes the responses from these agencies. Table 2-11 lists the species of concern. Since the time of development of the LTCP, the pallid sturgeon's spawning timeframe has been refined to be March 1 through June 30. Additionally, the Northern Long Eared Bat was listed as a state-threatened species. Nebraska Game and Parks Commission advised future listing actions of the Sicklefin chub in the reaches of the Missouri River, and delisting of the river otter, but advised that these listing/delisting actions are not official until the governor approves them, and until that time, their status should remain as-is. No other changes in species occurred since 2009.

TABLE 2-11
Species of Concern Identified by the Nebraska Game and Parks Commission

Species Name	Location	Type of Listing
Pallid Sturgeon	Missouri and Platte Rivers	Federal- and state-endangered
Lake Sturgeon	Missouri River	State-threatened
Sturgeon Chub	Missouri River	State-endangered
Blue Sucker	Missouri River	Tier 1 species
Sicklefin Chub[a]	Missouri River	State-endangered
Northern Long Eared Bat	Missouri River and Platte Rivers	State-threatened
River Otter[b]	Missouri River	State-threatened

[a] The Sicklefin Chub has the potential to be listed as endangered by the Nebraska Game and Parks Commission.

[b] The River Otter is currently in the process of being delisted.

The pallid sturgeon is the only federally listed endangered fish species whose habitat is the Missouri River. Pallid sturgeons are known to concentrate at the confluence of the Missouri River and the Platte River but are found uniformly along the river, occupying the edge between deep and shallow, and rocky and sandy. The lake sturgeon, sturgeon chub, and blue sucker are found in similar locations in the Missouri River. The river otter is found along the Papillion Creek, from its confluence with Big Papillion Creek to the Missouri River. The Northern Long Eared Bat is found throughout, in the Platte and Missouri Rivers Basin.

Summary of Sensitive Area Analysis

As a result of this analysis, it was determined that no new sensitive areas exist that could be impacted by the CSOs. At this time, no additional actions are needed in the 2021 LTCP Update to address endangered species impacts. Recovery of the pallid sturgeon or other species noted is not solely related to the mitigation of CSO discharges. While the City understands that environmental pollution may play a role, addressing this is beyond the scope of this LTCP Update. It is believed that the Council Bluffs Water Treatment Plant intake is not impacted by the CSO discharges upstream of its intake. The City has implemented several projects that have resulted in the reduction of the frequency and volume of the CSOs at CSO 105 and other projects are planned.

2.8 Status of Challenges

This section discusses the City's experience in dealing with several challenges since the 2014 LTCP Update while implementing the projects under the Program. These have included flooding in 2019, project issues associated with costs and schedule, and recently the COVID-19 virus.

2.8.1 2019 Missouri River Flood

In 2019, the Missouri River levels were above flood stage three times from March to September 2019. This section describes the events that led to the Missouri River Flood of 2019 (2019 Flood), the magnitude and duration of the flooding in the Omaha area, the impacts to the CSS, the City's ability to deliver flows to the WRRFs, and measures taken by the City to maintain the sewer system to the extent possible while attempting to protect the citizens of the City of Omaha and public and private property. Following is an abbreviated description of events related to the 2019 Flood. This information has been provided in greater detail in the City's CSO annual reports to the NDEE.

The 2019 Flood was much different than the 2011 Flood. The 2019 Flood included the Platte River and local tributaries, and it hit much quicker—without advance warning or opportunities to prepare. Figure 2-30 provides information on the 2018-2019 Missouri River levels as they relate to flood stages. The high river levels resulted in submerging most of the CSO outfalls for much of the year and creating saturated groundwater conditions that produced sustained river intrusion into the collection system.

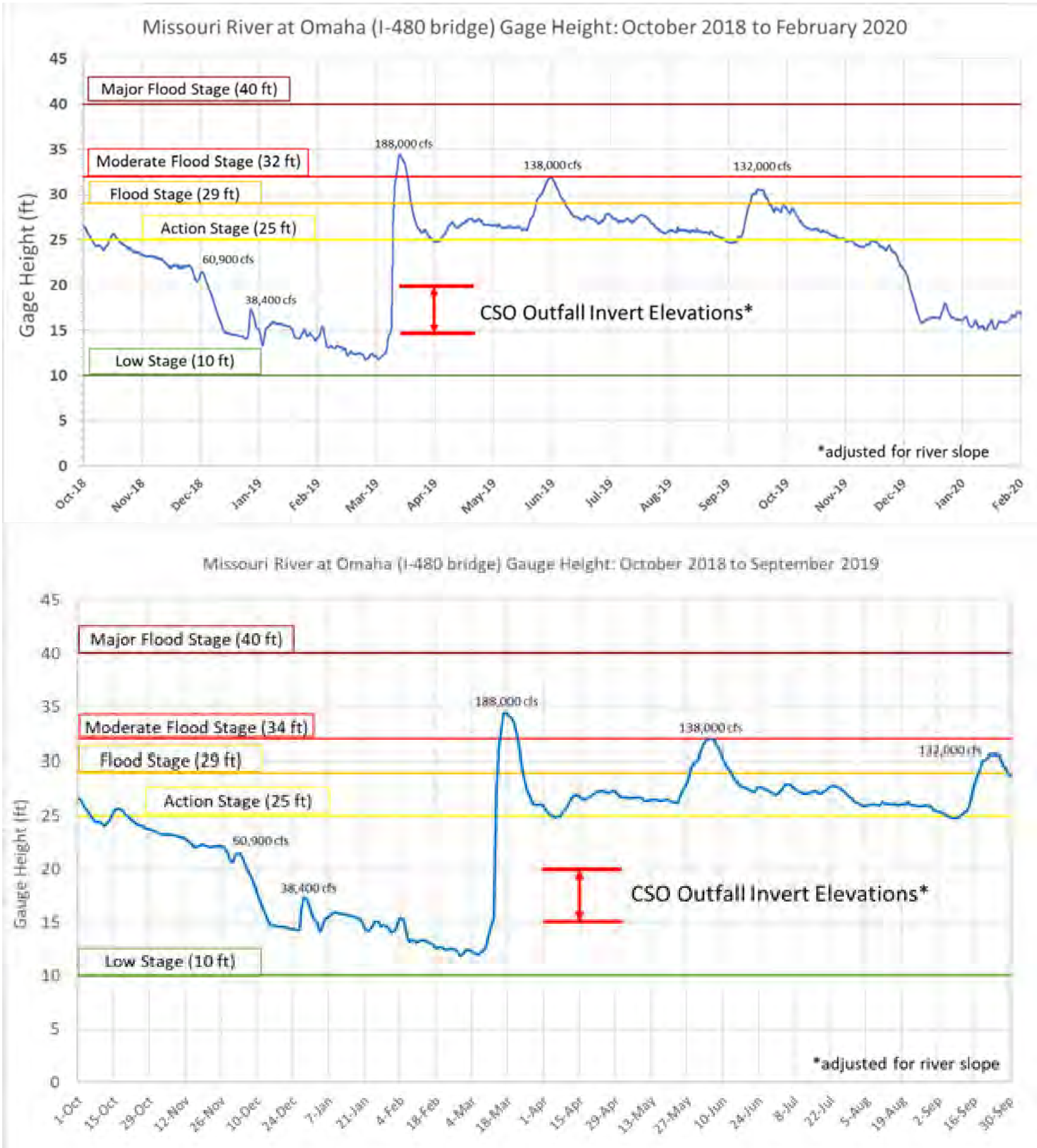

FIGURE 2-30
Flood Stages Associated with Action Levels for Operation of Wastewater and Levee Systems Emergency
Source: USGS

Figure 2-31 shows the annual flow volumes in the Missouri River at the Omaha I-480 Bridge for 2002 to 2019. While 2019 showed a major increase in the flow volume compared to previous years, it should be noted that flow volumes have been increasing and it is not uncommon for there to be spikes in the amount of flow in any given year. It should also be noted that the 2019 flow volume is the second highest recorded annual flow volume in this time period, with the flooding in 2011 resulting in the highest recorded annual flow volume.

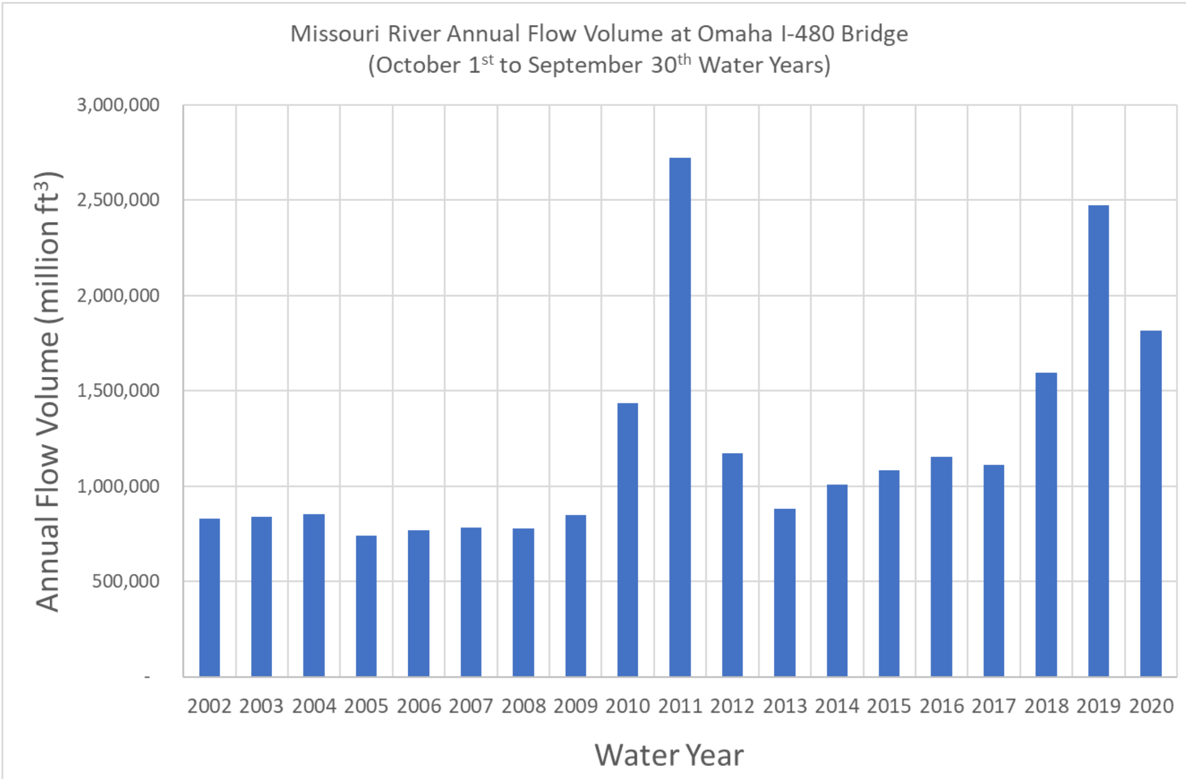

FIGURE 2-31
Annual Flow Volumes in the Missouri River at I-480 Bridge
Source: USGS

Many CSO projects and City facilities were impacted by the flooding, including construction of MRWRRF Improvements Schedule B2, construction of the Burt-Izard Lift Station Improvements, the Deep Tunnel System (DTS) Geotechnical Study, and the PCWRRF. Some of these impacts are discussed below:

- MRWRRF Improvements Schedule B2 – This CSO project was impacted because of the flood waters covering the construction site and filling the Chlorine Contact Basin with river water. This was exaggerated by backwater effects resulting from the Platte River flooding at the same time. Figure 2-32 shows the extent of the flooding at the MRWRRF.

FIGURE 2-32
Flooding at the MRWRRF Site in 2019

- Burt-Izard Lift Station Improvements – Because of the high river levels, construction stopped until river levels were reduced. In addition, the contractor for the project was redirected to assist at the PCWRRF site.
- DTS Geotechnical Study – The project team performing the borings for the DTS alignment study was delayed in finishing the borings as some of them were within the critical area of the levee. These were completed once the river flows reduced below action levels.
- The PCWRRF – Levees adjacent to the PCWRRF were overtopped on March 15, power to the facility was cut off, personnel evacuated, and floodwaters inundated the area (Figure 2-33). Untreated wastewater was discharged directly to the Missouri River for approximately 1 month while the facility was partially restored to provide primary treatment. Secondary treatment was restored by May 16, 2019. Details on this are included in the 2018 to 2019 Annual Report (City of Omaha, 2019).

FIGURE 2-33
March 2019 Flooding at PCWRRF

The City is continuing to address some of the issues that resulted from the 2019 Flood. It has been noted that while elevated water levels in the Missouri River above the Action Level are usually infrequent, what was once an anomaly is becoming a more common occurrence. To better address high river levels in the future, the City evaluated future controls to determine their operation during high river levels and ensure that they can operate, and if possible, provide benefit, should similar river levels occur in the future. This is discussed further in Section 3. In addition, the City has several projects under design that will provide additional flood protection to the WRRFs.

2.8.2 Project Cost Increases and Delays

Since the 2014 LTCP Update, the City has been challenged with project delays and increases in the costs of projects. During the initial implementation of the Program, construction costs were lower than anticipated as the economy struggled with a recession. However, since the 2014 LTCP Update, the economy has improved, resulting in increasing costs for the projects. In addition, there have been circumstances beyond flooding that have resulted in project delays and cost increases. These items are discussed in this section.

Overall costs of the CSO Program have increased beyond what was originally estimated for the design and construction of projects incorporated as part of the LTCP. The overall cost of the Program has increased from $1.66 billion in 2009 to $2.39 billion in 2020. The impact of the increased costs on ratepayers is discussed in Section 4. Sections 3 and 5 provide a summary of efforts that have been taken to reduce the costs.

The reasons for this increase in costs are varied. These include as follows:

- Unanticipated occurrences have resulted in cost increases. Examples of this include the need to stabilize the soil at the MRWRRF site prior to construction of the Chlorine Contact Basin, the trapped SIFM Tunnel boring machine and the finding of debris that needed to be removed in Adams Park. In addition, the MRWRRF improvements were broken into multiple design and construction packages due to the 2011 Flood.
- Limitations of the construction industry have resulted in an increase in project costs and a low number of bidders. Between 2009 and 2013 it was typical to receive four to eight bids on CSO projects; currently, getting only two to three bidders is more typical, and there have been several projects where only one bid was received. This situation was made worse because of the large amount of work due to the 2019 Flood.
- Labor rates have impacted the costs of projects because employers need to have competitive wages to retain their skilled workers. In addition, many employers are forced to hire craft workers from outside the region and pay per-diems to maintain or expand staff to meet the construction demand.
- Materials suppliers have also been impacted by the labor market and the ability to furnish and deliver materials for the construction industry. Increasing demand for building materials has driven concrete, steel, and other building materials pricing higher, affecting construction costs throughout the region.

In an attempt to attract more bidders and ultimately control costs, the City has, where possible, bid the project 6 or more months before the project must go to construction, which allows for contractors to fit the project into their backlog. The City has also taken efforts to engage contractors earlier in the project designs.

Delays in projects have also occurred, most often as the result of needing coordination with utilities and unforeseen circumstances. This includes the following:

- Schedules for several sewer separation projects have been delayed because of coordination working with M.U.D. CSO projects often require the relocation of M.U.D. gas and/or water distribution systems. M.U.D. must then design and construct these system facilities prior to the start of CSO project construction. M.U.D. has similar contracting difficulties as the City and has had to rely on its own crews to perform much of the work. This has resulted in delays in the schedule for relocations and, correspondingly, changes in the CSO Program. The City is dealing with these concerns by working closely with M.U.D. to develop suitable schedules.
- Unforeseen circumstances have not only resulted in an increase in costs but also project delays. The Bank Stabilization project at the MRWRRF site not only increased the costs of the Program, but the work resulted in a 2-year delay of the MRWRRF Improvement project.

To address these delays, the City has developed a schedule for future projects that includes contingencies for both anticipated delays such as those associated with the utilities and those that cannot be foreseen.

2.8.3 COVID-19

The implementation of the LTCP has been affected by the COVID-19 global pandemic. In the spring of 2020, there was a need to take immediate actions to comply with state- and citywide restrictions. The City of Omaha and CSO Program were affected and continue to respond and adapt to mandated changes. The City and project teams quickly adjusted to online meeting platforms without a delay. While more face-to-face meetings are being held now, it is anticipated that virtual meetings may continue for some time.

Construction projects have continued to progress with only minimal delays experienced. Contractors have incorporated health and safety requirements and are practicing social distancing on job sites. Stay at home orders and reductions in staffing to provide social distancing have resulted in delays with the manufacturing of equipment. For example, pump deliveries have been delayed for the Burt-Izard Lift Station project and the Transfer Lift Station project.

The other area impacted by the pandemic is public involvement. The City has developed creative ways to keep the community aware of important, ongoing projects. What used to be accomplished through in-person public meetings or visits with neighborhood associations, has now switched to social distance-friendly virtual platforms and tools to stay connected. This has included using email, phones, video conferencing, on-demand narrated presentations, and even short videos to keep neighbors and businesses informed about CSO projects as they proceed through design and construction.

2.9 Summary and Conclusions

The City has made significant progress in implementation of the LTCP over the last 15 years in reducing the impact of CSOs on the receiving waters. Accomplishments include the following:

1.) Completing 26 projects and, as of the end of 2019, achieving 56 percent volume capture in the Missouri River Basin and 84 percent volume capture in the Papillion Creek Basin. All sewer separation projects, except for Hickory and Pierce, are either in design or construction as of March 2021.

2.) As noted in Tables 2-1 and 2-2, the CSO projects have met all compliance dates in the CSO Permit.

3.) The construction of several green infrastructure projects that have provided some level of CSO control, reduced costs, and resulted in public amenities. Examples of this include Fontenelle Park Lagoon, Adams Park Wetlands, and re-establishment of Spring Lake Park.

4.) More accurately modeling the existing CSOs because of the expansion and continuous updating of the InfoWorks ICM model. This has allowed the City to better understand the system and impacts of changes. In addition, the development of a water quality model allows for the City to better understand the possible impacts on the receiving streams from the CSOs.

5.) An update to the Sensitive Areas, including the list of threatened and endangered species was performed; the result was that there were no changes to the sensitive areas and minor modifications to the species of concern.

6.) The City has faced several challenges since 2014 including increased project costs, flooding in 2019, delays as the result of utility coordination, and a global pandemic. The City has been able to adapt to these challenges and continue to make significant progress.

3 Evaluation of Alternatives

3.1 Introduction

This section provides a summary of evaluations of combined sewer overflow (CSO) controls that were done for the Missouri River and Papillion Creek Watersheds as part of the development of the 2021 Long Term Control Plan (LTCP) Update. In addition to meeting regulatory requirements and obtaining community acceptance, one of the key goals of the CSO Program is to minimize cost impacts to ratepayers. This is a primary focus of the CSO Program's Adaptive Management Process – to continually evaluate existing plans, identify new potential controls, and determine the most cost effective way to achieve water quality objectives. Since starting the development of the original LTCP in 2006, the City of Omaha (City) has learned more about its system and has developed better tools such as an updated and expanded collection system model and a water quality model, which assist in evaluation of various alternatives. In addition, through the design and construction of 26 LTCP projects, lessons have been learned on how best to implement projects and evaluate them. This section discusses the evaluations that were conducted since the 2014 LTCP Update.

As noted in Section 2, Current Status of the Program, projects in the Papillion Creek Watershed (PCW) are close to being completed. The PCW will achieve over 85 percent wet weather volume capture with the completion of the Saddle Creek Retention Treatment Basin (SCRTB) in 2023. There are still additional controls that are necessary for the Missouri River Watershed (MRW) to achieve 85 percent wet weather volume capture. It is estimated that with the completion of the projects currently under design or construction, the MRW will be at approximately 70 percent wet weather volume capture.

Most of Section 3 focuses on the Optimization Evaluation (Section 3.3), which analyzed many potential alternatives for going from 70 to 85 percent wet weather volume capture in the MRW. The Technical Assessment for Cost Savings (TACS), which was done in advance of the Optimization Evaluation, is also described (Section 3.2), and a few additional evaluations, conducted outside of the Optimization Evaluation or TACS, are also discussed (Section 3.4). The selected CSO controls are summarized in Section 5.

3.2 Technical Assessment for Cost Savings

The City structured the LTCP to implement the most effective projects first, in terms of volume capture and water quality benefits. Because of relatively high costs for the projects planned to go from 70 to 85 percent wet weather capture, the City challenged itself to re-evaluate those remaining LTCP projects and determine if they were still the most cost effective projects to achieve the 85 percent wet weather volume capture required in the United States Environmental Protection Agency (EPA) CSO Policy and the City's Consent Order.

In 2016, Program cost had increased and the City was looking for reductions in the total cost of the Program. One example of a significant cost increase was the Minne Lusa Stormwater Conveyance Sewer and associated sewer separation projects. The conveyance sewer project was put on hold due to both increasing cost and risk associated with levee and dam requirements. In addition, reports of basement backups in the Minne Lusa Basin, the reduction of which was a secondary objective of the projects, had been reduced due to the implementation of a check valve program and successes of sewer separation and green infrastructure projects implemented upstream in the Minne Lusa Basin. The City performed an evaluation to identify controls to achieve a minimum of 85 percent capture for the MRW without these Minne Lusa projects, with a goal to reduce costs by 10 to 20 percent of the remaining cost of the Program. This evaluation, referred to as the TACS, started in early 2017 and was finalized in early 2018 (City of Omaha, 2018).

The TACS evaluation reviewed more than 20 alternatives meeting the minimum requirement of 85 percent capture. It was assumed under TACS that a Deep Tunnel System (DTS) of some size would still be necessary to meet 85 percent volume capture. Alternatives evaluated included technologies such as storage tanks, outfall modifications (e.g., static weir increases, active controls), Minne Lusa Relief Sewer diversion modifications, sewer separation, utilization of the Minne Lusa Relief Sewer as a storm sewer that would discharge to Carter Lake, and extending the DTS further north from CSO 106 to CSO 105.

Additional potential cost savings measures that were developed under TACS included eliminating the storage tanks at CSOs 105, 118, and 119, and accounting for reduction in construction costs associated with the SCRTB re-design (described in Section 2). These additional cost saving alternatives also assumed construction of a tunnel system. However, one alternative was a collector tunnel concept to replace the DTS. The Collector Tunnel would be a shorter, larger-diameter tunnel that would equalize and convey CSO flows from CSOs 106 (North Interceptor), 107 (Grace Street), 108 (Burt-Izard Street), and 109 (1st and Leavenworth) to a retention treatment basin (RTB) located near the Leavenworth Lift Station. It would not include flow from CSO 115 (Riverview Lift Station) or extend to the Missouri River Water Resource Recovery Facility (MRWRRF) like the proposed DTS. The evaluation indicated the collector tunnel concept had potential for additional cost savings and warranted further evaluation to confirm the cost savings.

Upon review of costs, performance, and risks, the City determined that an appropriate first step was to replace the controls in the Minne Lusa Basin with revised controls. The best alternative included increasing the existing weir height at CSO 105 and modifying the use of the Minne Lusa Relief Sewer diversions using real-time active controls along with a DTS 15 feet in diameter extending from CSOs 106/107 to the MRWRRF. This alternative resulted in achieving the 20 percent cost reduction goal, saving approximately $330 million in the cost of the Program (as of August 2016). To evaluate the other potential controls that could result in significant additional savings, the City performed the Optimization Evaluation described in Section 3.3.

3.3 Optimization Evaluation of Missouri River Watershed

The Optimization Evaluation was focused on wet weather volume capture for the MRW as the primary requirement for Nebraska Department of Environment and Energy (NDEE) regulatory compliance. As noted previously, with completion of CSO control projects that are currently under design or construction in this watershed, it is estimated that approximately 70 percent capture will be achieved. The 2014 LTCP Update included a DTS and storage tanks to achieve greater than 85 percent capture. The Optimization Evaluation was conducted to determine if a more cost effective, beneficial approach might be available to achieve 85 percent volume capture, which is required by the EPA CSO Control Policy and the City's Consent Order with NDEE. A broad range of alternatives was considered, including both tunnel- and non-tunnel approaches.

This section provides a summary of the Optimization Evaluation, consisting of the following key phases of work:

- Optimization Analysis
- Vetting of High-Performing Alternatives
- Concept and Cost Verification

All of these phases of the Optimization Evaluation were necessary steps in identifying the selected approach for achieving 85 percent wet weather volume capture in the MRW. The selected approach is included among the CSO controls in Section 5.

Figure 3-1 summarizes the overall progression of work for the Optimization Evaluation that is described in this section, which moves from the evaluation of more than 100,000 potential alternatives to the selected alternative. The first three ovals represent the work in the Optimization Analysis, which evaluated a large number of alternatives and reduced the list to about 30 Solutions of Interest (SOIs) and then the five best alternatives, called High-Performing Alternatives (HPAs). The Vetting of High-Performing Alternatives evaluated those five alternatives and further reduced the list to the three, which were the focus of Concept and Cost Verification. The last step in the process was to select the alternative for inclusion in the 2021 LTCP Update. These three phases are addressed in Sections 3.3.1, 3.3.2, and 3.3.3, respectively.

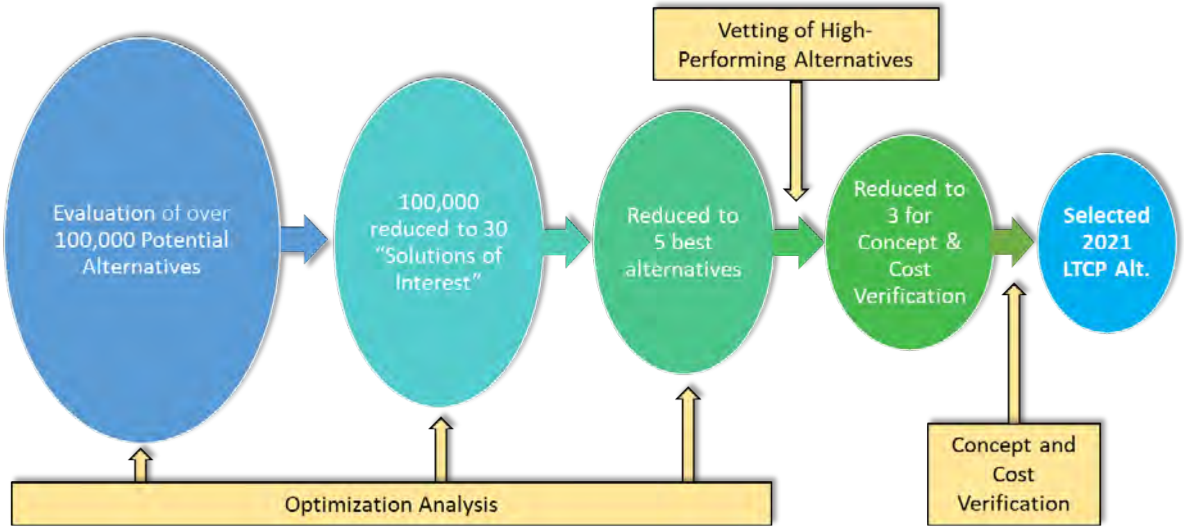

FIGURE 3-1
Optimization Evaluation Flowchart

3.3.1 Optimization Analysis

Specific objectives of the Optimization Analysis, which was the first phase of the overall Optimization Evaluation, included the following:

- Identify whether non-tunnel alternatives or a different tunnel configuration might provide a cost effective alternative to the LTCP tunnel-based solution (the DTS) to get from 70 to 85 percent capture.
- Evaluate a broad range of alternative components and wet weather control strategies to define the tradeoffs between cost and CSO volume reduction.
- Identify five HPAs that merit further evaluation under the subsequent phases of the Optimization Evaluation.

Optimization is a structured process used for decision-making when large numbers of options exist, and multiple variables are considered. For the CSO Program, an optimization process was used to evaluate a broad range of wet weather improvements, advancing from a large set of CSO control ideas, to a well-defined set of HPAs that clearly articulated tradeoffs in cost and performance. As the Optimization Analysis progressed, increased understanding was developed regarding the best performing alternative components, and how the system responded to combinations of components, helping to perform additional engineering reviews and consideration of components most likely to comprise the most cost effective CSO control solutions.

State-of-the-Art optimization software named Optimizer was used to perform the analysis of thousands of control alternatives. Optimizer is a commercial software that integrates several key capabilities required to perform optimization, as listed below:

- **Simulation automation**: Automatically runs many versions of hydraulic models to quantify system performance with alternative improvements. Optimizer translates selected decision values into the actual hydraulic model, executes a model simulation, and extracts results.
- **Computational capacity:** Optimizer links to the Amazon cloud, providing enormous computational capacity to run many alternative conditions models. Omaha's Optimizer subscription leveraged 16 InfoWorks ICM licenses concurrently, distributed over multiple multi-core Windows virtual machines, to enable roughly 50 concurrent simulations during an optimization run.
- **Algorithmic search:** Optimizer includes proprietary algorithms that "learn" from alternative performance as the optimization progresses. Alternatives with higher fitness (as quantified by the performance criteria defined by the user) contribute to an evolving population of alternatives, which evolves towards better and better solutions.

Omaha's hydraulic model, which uses InfoWorks ICM software, was modified by adding alternative components and then was imported into Optimizer. Optimizer then orchestrated the generation of unique, individual alternatives from the large number of alternative components defined.

The CSO Permit, requires that CSO controls need to be evaluated using the representative year rainfall. However, simulating the full representative year requires lengthy runtimes, and it was essential to significantly reduce runtimes to increase the number of alternatives that could be evaluated in a reasonable amount of time. A "proxy period" of rainfall was selected after an evaluation of several potential periods, to provide a strong predictor of representative year CSO volume impacts. The proxy period was selected from the representative year rainfall time series (5/20/1969 through 6/11/1969 but adjusted to have only a 36-hour inter-event time). The proxy period resulted in a much faster runtime of about 20 minutes for an InfoWorks ICM run, versus more than a 24-hour runtime with the full representative year rainfall time series. It also included two wet weather events, enabling rough estimation of CSO activation impacts, and including the impact of back-to-back wet weather events. More information about the selection of the proxy period is available in the Selection of a Proxy Period for Omaha CSO Program Optimization Technical Memorandum (TM; PMT, 2018), which is available upon request.

Many different versions of the hydraulic model were used in the phases of the Optimization Evaluation and final development of the 2021 LTCP Update. For better clarity, the versions are defined here, as follows:

- **Master Model**: City's primary collection system hydraulic model, representing approximate current conditions and updated on a regular basis to reflect new construction and system changes.
- **Optimization Baseline Model**: starting from the Master Model, the Optimization Baseline Model was created to provide a baseline condition for the Optimization Analysis. As explained later in this section, the baseline condition included CSO projects

in design or construction that were assumed to be completed. It excluded or simplified some model elements that were not needed, such as certain stormwater-only infrastructure and pipes in upper portions of basins far from alternative component locations. The simplifications facilitated faster simulations, which is essential when running thousands of alternatives.

- **Optimization Model**: starting from the Optimization Baseline Model, the Optimization Model included the alternative components that were being evaluated.
- **Stick Model**: a skeletonized version of the Optimization Model that represented the most downstream elements of the collection system, near CSO diversions and outfalls. This model was the most simplified of the hydraulic models, which allowed it to have much faster runtimes to provide early information to guide the optimization process.
- **Vetting Model**: a version of the Master Model used to vet the HPAs resulting from the Optimization Analysis (Section 3.3.2). There was a separate Vetting Model database for each HPA due to their different sewer system configurations. However, in most cases it is not necessary to refer to specific HPA versions, so the text simply refers to the "Vetting Model."
- **LTCP Model**: a version of the Master Model used to evaluate the performance of the LTCP as defined later in this 2021 LTCP Update (Section 5). It is similar to the Vetting Model for the selected HPA, but it includes other projects that were not part of the optimization but are part of the LTCP.

3.3.1.1 Optimization Analysis Process

The overall process that was followed during the Optimization Analysis is described below under various key headings. A more detailed summary of the Optimization Analysis and technical approach are presented in the Optimization of CSO Controls, Missouri River Watershed Report dated July 31, 2020, which is provided in Appendix E to this LTCP Update.

Alternative Components Summary

As noted previously, Optimizer orchestrated the generation of unique, individual alternatives from a large number of alternative components. Alternative components were identified as the individual projects that could be added to the baseline condition as control measures to increase wet weather capture. These components were used as input into Optimizer, along with specific sizing options such as storage tanks with 1, 5, or 10 million gallons (MG) of storage. The various combinations of alternative components comprise the space of possible solutions that Optimizer searched through. Combinations of alternative components create an "alternative" with an associated cost and CSO performance. The identification of alternative components was a critical step in the Optimization Analysis and was accomplished by a broad group of City and Program Management Team (PMT) staff, including an intensive 2-day workshop.

Overall, 158 alternative components were considered, which included the following technologies: control (such as active control or raising a weir), conveyance, inflow reduction (such as sewer separation and green infrastructure projects), inline storage, pumping, storage tanks, high-rate treatment, and tunnels. The 158 alternative components were prioritized for inclusion in optimization as discussed below, and 117 of them were ultimately included, distributed among technologies and basins as presented in Table 3-1. The following study basins were considered for the alternative components: Minne Lusa, Burt-Izard, Leavenworth, South Interceptor, Ohern/Monroe, and Cross-Basin (which includes components that affect multiple study basins, such as the Deep Tunnel).

TABLE 3-1
Alternative Component Summary by Basin and Technology

Technology	Minne Lusa	Burt-Izard	Leavenworth	South Interceptor	Ohern/ Monroe	Cross-Basin	Total
Control	8	11	1	4	0	0	**24**
Conveyance	1	3	2	0	0	0	**6**
Inflow Reduction[a]	15	8	5	6	9	0	**43**
Inline Storage	9	5	0	0	1	0	**15**
Pumping	0	0	1	0	0	1	**2**
Storage Tanks	4	2	1	1	3	0	**11**
High-rate Treatment	2	1	1	0	1	4	**9**
Tunnel	0	2	0	1	1	3	**7**
Total	**39**	**32**	**11**	**12**	**15**	**8**	**117**

[a] Inflow reduction was a general category that included technologies like sewer separation and green infrastructure that reduce inflow to the combined sewer system.

For alternative components, initial sizing options were defined based on a preliminary consideration of land availability, as well as an estimate of the volume needing to be managed. In the preliminary rounds of the optimization, land availability concerns were noted but not allowed to constrain the sizing range of options, thereby allowing the optimization to first define the amount of control a particular alternative would benefit from at a site. Further rounds of optimization increasingly constrained the options as site information was considered in greater detail.

To focus the optimization on the components most likely to form successful and cost effective alternatives, the 158 alternative components were prioritized on a scale of 1 to 6 based upon their potential effectiveness for CSO control, feasibility, and complexity to represent in the model. The prioritization guideline for the alternative components is described as follows:

- **Priority level 1**: Cross-basin alternatives and major near-outfall controls (e.g., storage tanks and RTBs)
- **Priority level 2:** Mid-system storage, static controls, and inline storage
- **Priority level 3**: Dynamic controls and components with more complexity to model and broad green infrastructure/inflow reduction assessment
- **Priority level 4:** Components requiring side study and/or having relatively minor expected overflow control potential

- **Priority level 5**: Separation projects, and side-study projects with greater complexity
- **Priority level 6**: Individual green infrastructure projects, components hydraulically equivalent to other projects, or infeasible components

Alternative components in priority levels 1, 2, and 3 (totaling the 117 shown in Table 3-1) were included in the Optimization Model. Some of the priority level 4 components were not included because they had very little benefit for CSO volumes, while others were further evaluated using side studies. Most of the priority levels 5 and 6 components were duplicated by other components in different priority levels or not feasible, so they did not need to be included. Side-study evaluations were performed for most components in priority level 4 and some components in level 5 to assess whether certain solutions were feasible and could result in enough CSO volume reduction to warrant the time and effort needed to include in the optimization. Twenty-eight side studies were conducted. The technologies considered in the side studies included inline storage, controls, storage, sewer separation, and pumping. The side-study evaluations are summarized in the Optimization of CSO Controls, Missouri River Watershed Report (Appendix E to this LTCP Update).

Advanced control strategies use sensor data, in combination with gates and valves, to actively control the sewer system—for example, by maximizing the use of existing in-system storage and the storage capacity of new facilities or directing flow away from a CSO diversion when conveyance capacity is available elsewhere—to achieve specific goals such as maximizing CSO volume reduction with a minimum addition of new facilities. These coordinated controls (using sensor data to support real-time decisions about how to best use system capacity for increased capture) can be thought of as a special type of alternative component that can augment an alternative via active management of the collection system. Active control strategies were considered in Optimizer for some of the alternative components, including components in the CSO 105 and CSO 121 basins.

Advanced control logic, whether included in the existing system model or considered as an alternative component for evaluation, alters how the sewer system responds to rainfall. Coordinated advanced control logic was not directly included in the Optimization Analysis because it depends on specialized algorithms, which are difficult to include in the InfoWorks ICM model. In coordination with the Optimization Analysis, but under a separate contract, the controls consultant EmNet performed an analysis of the potential for advanced control logic to provide enhanced CSO control. The EmNet report describes incremental benefits of including advanced control logic, showing improvements ranging from 0.003 to 0.5 percent increase in percentage of wet weather volume capture (out of the 85 percent wet weather capture requirement) for the eight alternatives that were evaluated, and is further addressed in Appendix E.

Development of Baseline Condition

All optimization evaluations were simulated against a common baseline condition, and improvements like CSO volume reduction and costs are in reference to the baseline condition. The Optimization Baseline Model achieves approximately 70 percent volume capture in the MRW as noted previously. The Optimization Baseline Model was derived from the City's Master Model to reflect the optimization baseline conditions. The baseline condition represents a specific state of the system, and establishing a baseline required decisions on which planned or designed projects should be included in the Optimization Baseline Model. Projects included in the 2014 LTCP Update that were in design or construction were included in the Optimization Baseline Model. The following 2014 LTCP Update projects that have not been started were not included in the optimization baseline condition:

- Pierce Street sewer separation (CSO 110 area) from 4th to 10th Streets, from Pierce Street to Pine Street
- Hickory Street sewer separation (CSO 111 area) from 2nd to 6th Streets, from Pine Street to Cedar Street
- Jones Street sewer diversion (CSO 121 area) to Leavenworth Street sewer (CSO 109 area)
- DTS
- Storage tanks at CSOs 105, 118, and 119

The Optimization Baseline Model was run for the representative year and the proxy period to summarize the optimization baseline CSO volumes and to confirm the accuracy of the proxy period approach.

Performance Criteria

As part of the evaluation of the alternatives, lifecycle costing of alternative components was performed to provide an estimate of the construction, capital, operation and maintenance (O&M), and replacement costs, and salvage value of alternative components. Lifecycle cost curves were developed and loaded into Optimizer. Construction costs in the cost curves were Class 5 (-50 percent/+100 percent). For comparison of alternatives, performance criteria were used, focusing on the hydraulic modeling results most relevant to the CSO Program. The performance criteria included the following:

- CSO Volume (MG): The total volume of CSO. Reducing this number from the baseline total of 86.6 MG to roughly 38.5 MG represented approximately 85 percent capture of the representative year wet weather volume (based on the proxy period of rainfall).
- CSO Activations (count): The total count of CSO activations provided an indicator of overall activation reduction in the representative year. While it was approximated, this metric was not used frequently because the back-to-back storms of the proxy period did not provide a clear indication of frequency reduction over the representative year.

It should be noted that the main performance criterion for the Optimization Analysis was volume capture with the number of activations being of less importance. Additional considerations beyond the modeled performance benefits and cost of an alternative were considered. These secondary criteria included the following categories:

- Adaptability
- Resilience
- O&M Impacts
- Community Impacts
- Additional Factors

Stick Model Exploratory Runs

Preliminary optimization runs were conducted using the Stick Model to evaluate the impact of improvement alternatives on wet weather capture. The Stick Model was defined previously. Inflow hydrographs from the Master Model representing the sewer system's runoff response in more upstream areas were used as input for the Stick Model.

Because the Stick Model was a simplified model, it ran faster, enabling much faster exploration of initial optimization solutions. Due to the faster runtime of the Stick Model and using the proxy period instead of the full representative year rainfall, Optimizer could evaluate more solutions rapidly to identify preliminary cost effective solutions for CSO control. In addition to the faster simulation runtimes, Optimizer setup and modification were much faster with the Stick Model. It was therefore more efficient to set up and test modeling approaches and associated optimization formulation using the Stick Model.

Because the Stick Model used inflow hydrographs to represent flows from the upstream basins, rather than modeling these basins explicitly, only alternative components near the outfall locations, the interceptor to the Water Resource Recovery Facility (WRRF), or at the WRRF could be included in the Stick Model optimization runs. Exploratory optimization runs performed with the Stick Model were helpful for debugging and testing the optimization formulation. Alternatives that performed well based on the Stick Model were used to seed the detailed optimization runs.

In addition, optimization runs were performed using up to 100 "seeded solutions," the maximum number supported by Optimizer. A seeded solution is an alternative that is input into the optimization directly by the user rather than being identified by the algorithm. The purpose of doing this is to give the algorithm a starting point so that optimal solutions are found with fewer iterations.

Optimization Model Runs

Once the alternative component modeling and optimization approaches were tested using the Stick Model optimization setup, and initial better-performing solutions were identified, the detailed model optimization formulation was created in Optimizer.

Most of the Optimization Analysis was conducted using Optimizer with the Optimization Model. Additional components such as inline storage, upstream storage locations (e.g., Gunderson, South Omaha Industrial Area [SOIA]), dynamic controls (e.g., 33rd and Paxton), and inflow reduction were represented in the Optimization Model. Results extracted from Optimizer were postprocessed and reviewed using interactive visualization tools to help identify higher performing solutions, potential SOIs, and to understand which alternative components were included in individual alternatives.

Identification of Solutions of Interest

The optimization process resulted in more than 100,000 high-level alternatives. Tradeoff curves were used to capture and visualize general trends between cost and CSO volume across all alternatives. Figure 3-2 shows a tradeoff curve summarizing the output data produced during the optimization process. Each point in Figure 3-2 represents an alternative, and the colors are based on the predominant control technology in each alternative (i.e., tunnel, storage, or RTB). Specific SOIs were identified from detailed review of optimization output, based on the following criteria:

- Cost effective alternatives for achieving 85 percent volume capture (which fall along the left edge of the points shown on Figure 3-2). In addition, some alternatives providing slightly higher or slightly lower wet weather capture were identified to understand how alternative composition might change with varying wet weather capture percentages.
- Alternatives from core strategies (tunnel and non-tunnel controls).
- Alternatives that included specific alternative components of interest, such as potential use of the old South Interceptor Force Main (SIFM).
- Alternatives that provided significant CSO control at each major outfall (as opposed to leaving one or more major CSOs without further control).

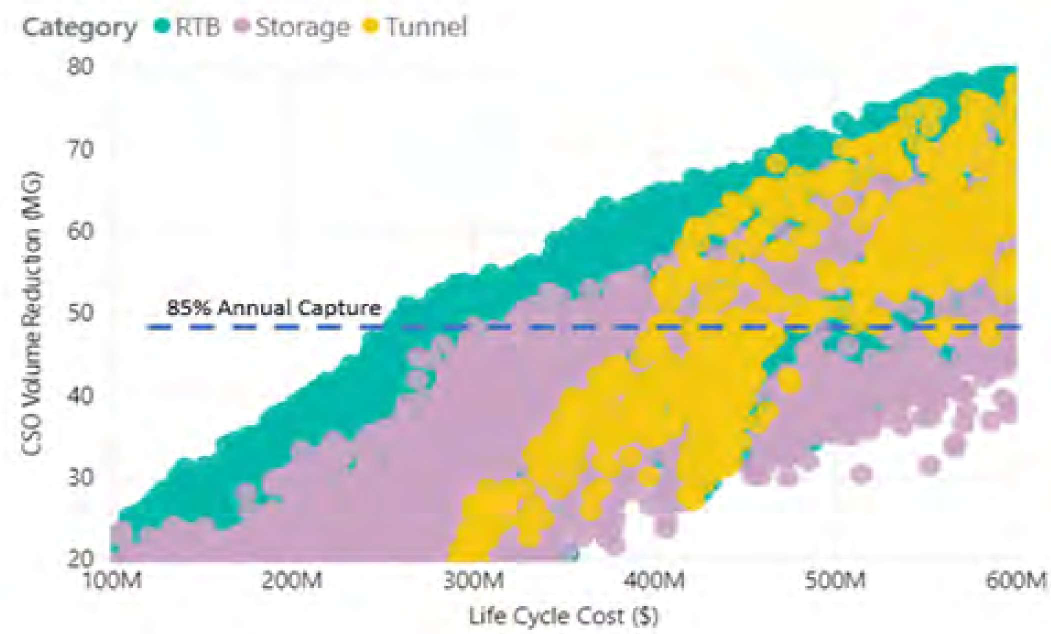

FIGURE 3-2
CSO Volume versus Lifecycle Cost by Primary Technology

More information about the SOIs is provided in the section below discussing results from the Optimization Analysis.

Identification of High-Performing Alternatives

The goal of the Optimization Analysis was to define a short list of potential alternatives for achieving 85 percent capture of wet weather volume. SOIs identified several promising strategies for achieving 85 percent capture or beyond. HPAs were a more focused list of five alternatives, which allowed the development of more detailed cost estimates, engineering review to verify and enhance performance, and assessment of feasibility. All HPAs provided a minimum of 85 percent wet weather capture (based upon the proxy period analysis) and were further evaluated under the vetting and concept and cost verification phases described later. More information about the HPAs is provided in the next section.

3.3.1.2 Results of Optimization Analysis

Following is a summary of results of the Optimization Analysis, including the identification of SOIs and HPAs.

Solutions of Interest

The optimization algorithm produced a broad range of alternatives, from the very minor alternatives ($20 million or less), to solutions exceeding $1 billion in cost. Tradeoff curves showing proxy period CSO volume versus lifecycle cost (like Figure 3-2) were used to show trends in most cost effective solutions and were prepared for the results between roughly $200 million and $600 million, the range spanning CSO volume reductions correlating to 80 to 90 percent wet weather capture. This is the region of the solution space of greatest interest for identifying SOIs and is shown on Figure 3-3. The gray dots in the figure indicate individual alternatives; specific alternatives that were selected as SOIs are highlighted in color and symbolized by core strategy as follows:

- **Non-tunnel Solutions (NTS):** Solutions that do not include a tunnel.
- **Short Tunnel System (STS):** Shorter, larger-diameter tunnel between CSOs 106/107 and CSO 108 (plus lift station/RTB).
- **Collector Tunnel System (CTS**): Collects overflows from the highest concentration of major overflow locations, including CSOs 106/107, 108, and 109 (plus lift station/RTB).
- **DTS:** Extends from CSOs 106/107 to the MRWRRF (plus lift station/RTB). (A version of the DTS was included in the 2014 LTCP Update to go from 70 percent to above 85 percent wet weather volume capture.)

The alternatives in Figure 3-3 along the left edge of the gray dots are the most cost effective solutions at a given range of CSO control (shown on the y-axis as total CSO volume). The SOIs included alternatives that did not fall on the left edge (and therefore were not the most cost effective), to ensure that each core strategy was represented by the SOIs, as well as to include alternatives that achieved additional goals beyond 85 percent capture (for example, NTS.R3.Ref3 used only storage tanks instead of RTBs, and alternative NTS.R3.3 included the use of a specific asset of interest, the Old SIFM). Twenty-six SOIs were identified for consideration. The names of the alternatives start with "CTS," "NTS," etc., to identify whether a tunnel is included, and then use numbers and letters as names to differentiate the alternatives from other Optimization Analysis results. The specific "codes" are not important other than functioning as references.

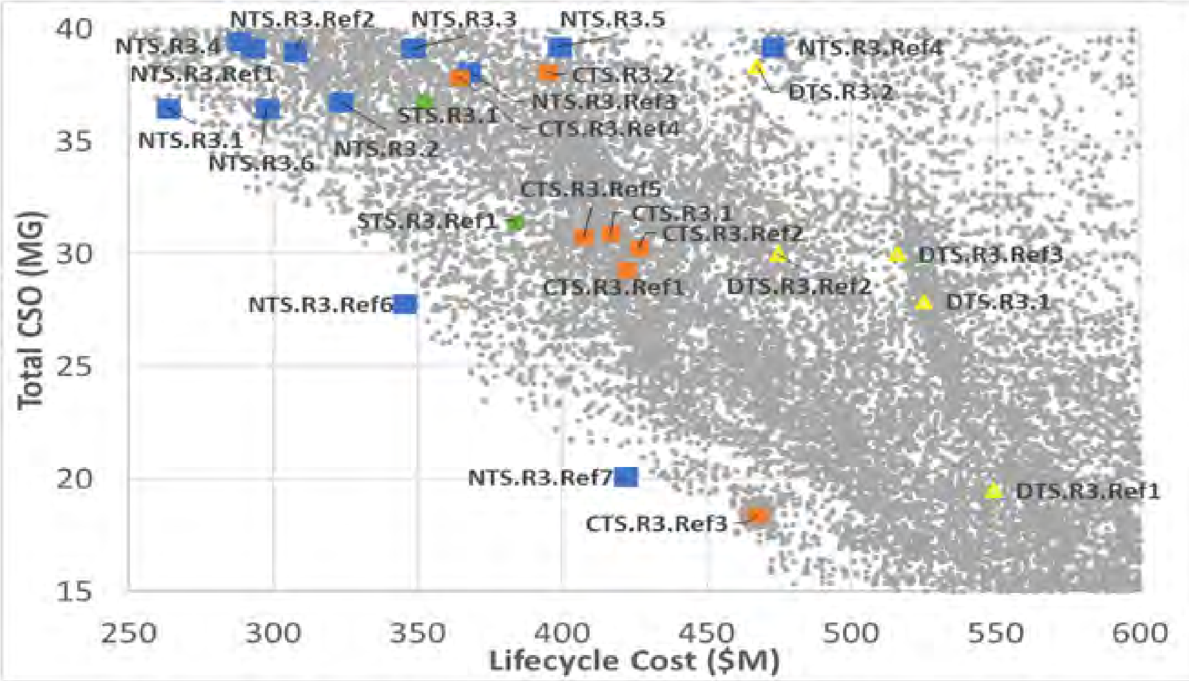

FIGURE 3-3
Solutions of Interest Overlay on Tradeoff Curve[1]

The 26 SOIs were summarized in a table along with lifecycle cost, capital cost, control strategy, and the estimated percent capture based upon the proxy period CSO volume. Individual maps were provided for each SOI to show the location and sizing of selected alternative components.

High-Performing Alternatives

SOIs represented numerous strategies for achieving 85 percent capture or beyond. HPAs were a more focused list of five alternatives, which allowed the development of more detailed cost estimates, engineering review to verify and enhance performance, and assessment of feasibility. Five HPAs were selected from the 26 SOIs to represent the best distinct strategies for achieving 85 percent capture. These alternatives were not simply the most cost effective alternatives providing 85 percent wet weather capture, as the optimization produces many very similar alternatives. Inclusion of these alternatives was based upon the acknowledgment that other factors, including the secondary criteria, could be important in determining the preferred alternative for the 2021 LTCP Update.

[1] Gray dots show individual alternatives; colored symbols highlight the Solutions of Interest, grouped by core strategy (DTS, CTS, STS, or NTS)

The five HPAs identified from the 26 SOIs and reference solutions are briefly described in the list following. Table 3-2 shows the alternative components, percent capture, capital costs, and lifecycle costs for the HPAs.

- **CTS.R3.Ref4:** includes a raised weir at CSO 105, Drop Shaft (DS)/Tunnel at CSOs 106/107, 108, and 109, and 15-MGD lift station located south of the Leavenworth Lift Station to dewater the tunnel to the MRWRRF
- **NTS.R3.1:** includes active controls at CSO 105 and CSO 108, and RTBs at CSOs 106/107 and 109
- **NTS.R3.2:** includes active control at CSO 105, RTB at CSOs 106/107, conveyance to RTB from CSO 108 basin, and a storage tank at CSO 109
- **NTS.R3.Ref1:** includes active controls at CSO 105 and CSO 108, RTB at CSOs 106/107, and storage tanks at both CSO 109 and CSO 118
- **NTS.R3.3:** includes active controls at CSO 105 and CSO 108, RTBs at CSOs 106/107 and CSO 118, and conveyance (through rehabilitated SIFM) and lift station at CSO 109 to the RTB at MRWRRF (treating flows from both CSO 109 and CSO 118)

TABLE 3-2
Key Facilities for High-Performing Alternatives

Alternative	Lifecycle Cost ($million)	Capital Cost ($million)	Percent Capture ($ / gallon)	Primary Control Strategy by Major Outfall[a]				
				CSO 105	CSO 106/107	CSO 108	CSO 109	CSO 118
CTS.R3.Ref4	$365	$358	85.0% ($0.58)	3.5' Static Weir Raise	23' diam. Tunnel	23' diam. Tunnel	23' diam. Tunnel	
NTS.R3.1	$264	$210	85.5% ($0.47)	Active Control	79.5 MGD RTB	Active Control	82.4 MGD RTB	
NTS.R3.2	$323	$272	85.4% ($0.58)	Active Control	170 MGD RTB	60" Conveyance to RTB	5.5 MG Tank	
NTS.R3.Ref1	$293	$257	84.8% ($0.55)	Active Control	79.5 MGD RTB	Active Control	4.6 MG Tank	6.8 MG Tank
NTS.R3.3	$348	$290	84.8% ($0.65)	Active Control	79.5 MGD RTB	Active Control	30 MGD Lift Station	82.2 MGD RTB

[a] Colors indicate similar control strategies.

The list of HPAs and some relative strengths and weaknesses are presented in Table 3-3. While cost effectiveness for CSO control can be quantified, the strengths and weaknesses included additional factors that could influence the selection or rejection of an alternative.

TABLE 3-3
High-Performing Alternative Strengths and Weaknesses

Alternative	Strength(s)	Weakness(es)
CTS.R3.Ref4	Consolidated facility addressing several major CSO locations	Higher cost Fewer phasing opportunities
NTS.R3.1	Lowest cost	Multiple remote RTBs Less control at CSO 108 Challenge of coordinating with Convention Center
NTS.R3.2	More control at CSO 108 (among NTS alternatives), fewer remote RTBs	More costly than NTS.R3.1
NTS.R3.Ref1	More storage, leading to more flows receiving secondary treatment	Three major facilities (1 RTB, 2 Tanks) Higher cost
NTS.R3.3	Reuse of existing asset (Old SIFM) SIFM redundancy between CSO 109 and MRWRRF	Higher cost of conveying flows to be treated downstream, versus treating near CSO 109 Three major facilities (2 RTBs, 1 lift station)

3.3.1.3 Optimization Analysis Conclusions

The Optimization Analysis provided a thorough and technically informed process for evaluating a comprehensive suite of potential improvements to the Omaha system. This process helped the City progress from a broad set of project ideas to a focused list of five HPAs, through a series of steps as follows:

- Ideas, goals, and information from diverse stakeholders with deep knowledge of the Omaha collection system were integrated throughout the optimization process.
- Optimization and cloud computing were leveraged to apply the Omaha hydraulic model to more than 100,000 alternatives, comparing the costs and benefits of an enormous set of potential CSO control alternatives.
- Twenty-six SOIs were identified. Alternative components and overflow impacts for these solutions were compared in greater detail when discussing the merits of individual solutions.
- A set of five HPAs was defined, representing distinct, cost effective means of achieving 85 percent capture.

The five HPAs varied in estimated lifecycle cost from approximately $260 million to roughly $400 million. Additional consideration of the assumptions of this analysis and refinement of these HPAs were required before making a final recommendation for the 2021 LTCP Update. The additional phases of the Optimization Evaluation—Vetting of High-Performing Alternatives and Concept and Cost Verification—are described in the following sections.

3.3.2 Vetting of High-Performing Alternatives

As noted previously, the Optimization Analysis used a modified version of the City's Master Model that excluded or simplified some model elements and a proxy rainfall period for analysis, rather than the full representative year rainfall time series. This approach was necessary to facilitate the evaluation of more than 100,000 alternatives; but it also made it necessary to later confirm that the HPAs would still achieve 85 percent capture using detailed modeling of alternative components and real-time controls (RTCs) and the full representative year rainfall time series. A vetting analysis was conducted to reduce the list of five HPAs to three HPAs for cost and concept verification, and to confirm performance using the detailed Vetting Model and representative year rainfall for adjustments to facility sizes. Further information about the vetting process can be found in the TM entitled Vetting of High Performing Alternatives*,* dated October 13, 2020, which is provided in Appendix F.

As previously described, the Vetting Model was a version of the Master Model used to vet the HPAs resulting from the Optimization Analysis. There was a separate Vetting Model database for each HPA due to their different sewer system configurations. However, in most cases it is not necessary to refer to specific HPA versions, so the text simply refers to the "Vetting Model."

3.3.2.1 Description of Five High-Performing Alternatives

Descriptions of the five HPAs that resulted from the Optimization Analysis are provided in the following list, with additional detail from what was presented previously. There was one HPA with a CTS; the other four HPAs included various mixes of storage and treatment facilities and did not include a tunnel (NTS).

CTS.R3.Ref4 (CTS with 15-MGD Lift Station to MRWRRF)

- 23-foot diameter, 11,000 linear feet (LF) Collector Tunnel extending from CSOs 106/107 to CSO 109
- Drop shafts at CSOs 106/107, 108, and 109 (three drop shafts total)
- 15-MGD lift station located near CSO 109 to dewater the tunnel for treatment
- Static weir level increase of 3.5 feet at CSO 105
- Inline storage at two locations along the North Interceptor (upstream of CSO 106) and one location along the Minne Lusa east interceptor (upstream of CSO 105)
- Closure of the dry-weather flow gate at the CSO 107 diversion structure during wet weather to maximize flow to the nearby drop shaft
- Changes to the existing 20th/Poppleton stormwater infiltration facility to detain more flow in smaller storms (upstream of CSO 109)

NTS.R3.1 (Lowest Cost 85 Percent - Two Satellite RTBs)

- 79.5-MGD RTB at CSOs 106/107
- 82.4-MGD RTB at CSO 109
- Active control at CSO 105

- Inline storage at CSO 108 in three locations: Sewer #2, Sewer 1040, and Webster Sewer
- Inline storage at one location along the North Interceptor (upstream of CSO 106)
- Active control at 16th/Cornish to divert more flow into a 48- to 72-inch sewer that parallels the North Interceptor, rather than sending all that flow via the North Interceptor toward CSO 106
- Closure of the dry-weather flow gates at the CSOs 106 and 107 diversion structures during wet weather to maximize flow to the RTB at CSOs 106/107
- Changes to the existing 20th/Poppleton stormwater infiltration facility to detain more flow in smaller storms (upstream of CSO 109)

NTS.R3.2 (11th/Izard Conveyance – One Satellite RTB and One Tank)

- 170.4-MGD RTB at CSOs 106/107
- 5.5-MG storage tank at CSO 109
- Active control at CSO 105
- Conveyance of flow in a proposed 60-inch pipe from CSO 108 basin at 11th/Izard to the RTB along with active control at 11th/Izard and 21st/Cuming (upstream in CSO 108 basin)
- Closure of the dry-weather flow gates at the CSOs 106 and 107 diversion structures during wet weather to maximize flow to the RTB
- Active control at CSO 115

NTS.R3.Ref1 (One Satellite RTB and Two Tanks)

- 79.5-MGD RTB at CSOs 106/107
- 4.6-MG storage tank at CSO 109
- 6.8-MG storage tank at CSO 118
- Active control at CSO 105
- Inline storage at CSO 108 in three locations: Sewer #2, Sewer 1040, and Webster Sewer
- Closure of the dry-weather flow gates at the CSOs 106 and 107 diversion structures during wet weather to maximize flow to the RTB
- Changes to the existing 20th/Poppleton stormwater infiltration facility to detain more flow in smaller storms (upstream of CSO 109)

NTS.R3.3 (Old SIFM – One Satellite RTB and One RTB at MRWRRF)

- 79.5-MGD RTB at CSOs 106/107
- 82.2-MGD RTB at CSO 118, receiving flow from CSO 109 and CSO 118

- 30-MGD wet weather pump station at CSO 109, pumping through Old SIFM to RTB at CSO 118; includes rehabilitation and reconfiguration of Old SIFM for this purpose
- Active control at CSO 105
- Inline storage at CSO 108 in three locations: Sewer #2, Sewer 1040, and Webster Sewer
- Inline storage at two locations along the Minne Lusa east interceptor (upstream of CSO 105)
- Closure of the dry-weather flow gates at the CSOs 106 and 107 diversion structures during wet weather to maximize flow to the RTB at CSOs 106/107
- Changes to the existing 20th/Poppleton stormwater infiltration facility to detain more flow in smaller storms (upstream of CSO 109)

Most of the optimization simulations used the proxy period rainfall, but the Optimization Model was also run with the HPAs for the representative year precipitation to evaluate whether conclusions might be skewed due to the use of the proxy period as a predictor. The total CSO volumes and the estimated representative year wet weather volume captures based on Optimization Model results for both the representative year and the proxy period were compared for each HPA. This result showed that, in general, the predicted wet weather volume capture from the proxy period was close to the representative year wet weather volume capture. It also showed the importance of using the representative year rainfall to confirm sizes for the HPAs, especially in cases where the proxy period was above 85 percent capture and the representative year was under 85 percent.

3.3.2.2 Evaluation of HPAs and Adjustments

As the first step in evaluating the HPAs, CSO control facilities were input to the Vetting Model. The incorporation of the HPAs into the Vetting Model included the following efforts:

- Copying individual HPA elements from the Optimization Model to separate Vetting Model networks for each of the five HPAs
- Setting up influent/bypass control, storage, and dewatering for storage and treatment facilities
- Setting up pumping controls for pump station facilities
- Setting up active control facilities and developing RTC operations for some of the facilities

Table 3-4 shows the results from the Vetting Model with representative year rainfall and includes the results from the Optimization Model for comparison. The differences between the Optimization Model and the Vetting Model results underscore the importance of using the Vetting Model to confirm HPA performance. The HPAs needed to be adjusted to confirm 85 percent capture. The goal of this evaluation was to put the HPAs on equal footing for comparison. Two types of adjustments were made to the HPAs: adjustments to facilities to reach 85 percent capture and adjustments related to performance during high river levels.

TABLE 3-4
Comparison of Vetting Model and Optimization Model Results for Original HPAs

HPA	Vetting Model		Optimization Model	
	Rep. Year CSO Volume	Rep. Year Wet weather Volume Capture	Rep. Year CSO Volume	Rep. Year Wet weather Volume Capture
CTS.R3.Ref4	618 MG	85.5%	624 MG	85.3%
NTS.R3.1	693 MG	83.7%	644 MG	84.8%
NTS.R3.2	654 MG	84.6%	653 MG	84.6%
NTS.R3.Ref1	653 MG	84.6%	650 MG	84.7%
NTS.R3.3	657 MG	84.5%	639 MG	85.0%

Adjustment to Facilities

The length of the Collector Tunnel was shortened from the length during the Optimization Analysis of 11,000 LF to 9,940 LF during the vetting phase based on the current understanding of the most probable horizontal alignment for the tunnel. For adjustment to facilities, since the length of the Collector Tunnel was shortened, it was necessary to determine the diameter of tunnel that would allow the shorter tunnel to reach 85 percent capture. In addition, the static weir level increase at CSO 105 was changed to an active control due to a concern about needing flexibility to minimize the risk of flooding. The tunnel diameter was further refined and a RTB was added to the alternative after evaluation for high river levels, as explained below. For the NTS HPAs, the primary focus for increasing capture to confirm 85 percent was to increase the treatment rates of the RTBs as needed in each alternative. This approach was used because the RTBs provided a significant portion of the wet weather capture in these alternatives and doing so minimized the number of changes between the HPAs defined in the Optimization Analysis and the HPAs revised through vetting.

High-River Level Evaluations

The Missouri River flooding event of 2019 emphasized the need for the combined sewer system (CSS) to perform adequately under conditions when levels in the Missouri River are high. The City closes bulkhead gates at many CSO outfalls when the river is flooding, so overflows are not possible, and it can take days to drain the sewer system after a storm event. As a result, the HPAs were evaluated under high-river conditions to determine if there were significant differences among the performance of the HPAs. The performance criterion was defined as restoring the sewer system and CSO controls to normal operations within approximately 24 hours of the end of precipitation for a 1-year 24-hour design storm with the Missouri River at 29-foot stage (which was flood stage at the time of the analysis). An alternate version of the Vetting Model was developed to evaluate the system with closed bulkhead gates and to minimize flooding to the ground surface to better understand the volume and time needed to drain the sewer system. Modeling showed that the volume of flow needing to be controlled by a CSO facility from a 1-year 24-hour design storm under high-river conditions with bulkhead gates closed was approximately 70 to 80 MG. A key finding was that the CTS.R3.Ref4 HPA would not be able to meet the 24-hour system draining target because its 15-MGD lift station would require 4 or 5 days to dewater the wet weather volume back to the collection system to be treated at the MRWRRF. The tunnel itself provides just under 17 MG of storage, so it would need to be filled multiple times to drain this volume of wet weather flow from the collection system. Therefore, it was necessary to add a RTB to the HPA so that the tunnel could be dewatered to the RTB and the wet weather flow could be managed in a much shorter period. The tunnel lift station size was increased from 15 MGD to 50 MGD to match the RTB treatment rate. After modifying this HPA to include a 50-MGD RTB, the alternative was referred to as the CTS HPA.

Description of Revised HPA Components

Table 3-5 provides a comparison of the HPA components between the original HPAs from the Optimization Analysis and the revised HPAs after the vetting work was completed. Elements that were revised are in gray.

TABLE 3-5
Comparison of Original and Revised HPAs

Original HPA from Optimization Analysis	Revised HPA after Adjustment
CTS.R3.Ref4 (referred to as "CTS HPA" after adjustment)	
23-foot diameter, 11,000 LF Collector Tunnel	17-foot diameter, 9,940 LF Collector Tunnel
Drop shafts at CSOs 106/107, 108, 109	Drop shafts at CSOs 106/107, 108, 109
15-MGD Lift Station near CSO 109 for dewatering to combined sewer system	50-MGD Lift Station to RTB
	50-MGD RTB near CSO 109
Static weir level increase of 3.5 feet at CSO 105	Active control at CSO 105
Inline storage – North Interceptor Structure 1	Inline storage – North Interceptor Structure 1
Inline storage – North Interceptor Structure 2	Inline storage – North Interceptor Structure 2
Inline storage – Minne Lusa east Structure 2	Inline storage – Minne Lusa east Structure 2
Closure of DWF gate at CSO 107	Closure of DWF gate at CSO 107
Changes to 20th/Poppleton stormwater facility	Changes to 20th/Poppleton stormwater facility
NTS.R3.1	
79.5-MGD RTB at CSOs 106/107	105-MGD RTB at CSOs 106/107
82.4-MGD RTB at CSO 109	115-MGD RTB at CSO 109
Active control at CSO 105	Active control at CSO 105
Active control at three locations for CSO 108	Active control at three locations for CSO 108
Inline storage – North Interceptor Structure 1	Inline storage – North Interceptor Structure 1
Flow diversion at 16th/Cornish	Flow diversion at 16th/Cornish
Closure of DWF gates at CSOs 106 and 107	Closure of DWF gates at CSOs 106 and 107
Changes to 20th/Poppleton stormwater facility	Changes to 20th/Poppleton stormwater facility
NTS.R3.2	
170.4-MGD RTB at CSOs 106/107	185-MGD RTB at CSOs 106/107
5.5-MG storage tank at CSO 109	5.5-MG storage tank at CSO 109
Active control at CSO 105	Active control at CSO 105
Conveyance of flow from 11th/Izard	Conveyance of flow from 11th/Izard
Active control at 11th/Izard	Active control at 11th/Izard

TABLE 3-5
Comparison of Original and Revised HPAs

Original HPA from Optimization Analysis	Revised HPA after Adjustment
Active control at 21st/Cuming	Active control at 21st/Cuming
Closure of DWF gates at CSOs 106 and 107	Closure of DWF gates at CSOs 106 and 107
Active control at CSO 115	Static weir at CSO 115[a]
	Modifications to MLRS Diversions
NTS.R3.Ref1	
79.5-MGD RTB at CSOs 106/107	90-MGD RTB at CSOs 106/107
4.6-MG storage tank at CSO 109	4.6-MG storage tank at CSO 109
6.8-MG storage tank at CSO 118	6.8-MG storage tank at CSO 118
Active control at CSO 105	Active control at CSO 105
Active control at three locations for CSO 108	Active control at three locations for CSO 108
Closure of DWF gates at CSOs 106 and 107	Closure of DWF gates at CSOs 106 and 107
Changes to 20th/Poppleton stormwater facility	Changes to 20th/Poppleton stormwater facility
NTS.R3.3	
79.5-MGD RTB at CSOs 106/107	90-MGD RTB at CSOs 106/107
82.2-MGD RTB at CSO 118	90-MGD RTB at CSO 118
30-MGD wet weather pump station at CSO 109	30-MGD wet weather pump station at CSO 109
Active control at CSO 105	Active control at CSO 105
Active control at three locations for CSO 108	Active control at three locations for CSO 108
Inline storage – Minne Lusa east Structure 1	Inline storage – Minne Lusa east Structure 1
Inline storage – Minne Lusa east Structure 2	Inline storage – Minne Lusa east Structure 2
Closure of DWF gates at CSOs 106 and 107	Closure of DWF gates at CSOs 106 and 107
Changes to 20th/Poppleton stormwater facility	Changes to 20th/Poppleton stormwater facility

[a] NTS.R3.2 was the only HPA with active control at CSO 115. The overflow volume reduction at CSO 115 was small, and it is expected that this component was included by Optimizer because it was inexpensive and therefore cost effective, even though its benefit was small. The model shows that raising the CSO 115 weir tends to push flow upstream to the CSO 114 diversion, where it can overflow. It is important to consider these two locations together and ensure that no adverse impacts will result. Therefore, this control was changed to a static weir for the vetting evaluation. Raising the weir elevations at these two structures (which are currently under construction) can easily be achieved by adding stop logs once the impacts are fully understood.

Notes:

Shading indicates components that are different in the adjusted HPAs.

DWF = dry-weather flow

MLRS = Minne Lusa Relief Sewer

Addition of Collector Tunnel System with Joint Drop Shaft

Due to ongoing significant redevelopment occurring near CSO 108, it was determined to be beneficial to evaluate a variation of the CTS HPA that excluded the drop shaft for CSO 108 and instead used conveyance from 11th/Izard (along with active control at 11th/Izard and 21st/Cuming) to a joint drop shaft (JDS) for CSOs 106, 107, and 108 located at the same site as the drop shaft for CSOs 106/107 in the regular CTS HPA. The 11th/Izard location would take flow from Sewer 1040 to the JDS, but there was no mechanism for capturing flow from Sewer #2 with the tunnel. As a result, this HPA required a slightly larger tunnel to compensate for the less efficient capture of Burt-Izard flow. Table 3-6 compares the components in the vetted version of the CTS HPA and the CTS JDS HPA. Elements that were revised are in gray.

TABLE 3-6
Comparison of CTS HPA and CTS Joint Drop Shaft HPA

Vetted CTS HPA	CTS JDS
17-foot diameter, 9,940 LF Collector Tunnel	17.5-foot diameter, 9,940 LF Collector Tunnel
Drop shafts at CSOs 106/107, 108, 109	Drop shafts at CSOs 106/107 and 109
	Conveyance from 11th/Izard to 106/107 Drop Shaft
	Active control at 11th/Izard
	Active control at 21st/Cuming
50-MGD Lift Station to RTB	50-MGD Lift Station to RTB
50-MGD RTB near CSO 109	50-MGD RTB near CSO 109
Active control at CSO 105	Active control at CSO 105
Inline storage – North Interceptor Structure 1	Inline storage – North Interceptor Structure 1
Inline storage – North Interceptor Structure 2	Inline storage – North Interceptor Structure 2
Inline storage – Minne Lusa east Structure 2	Inline storage – Minne Lusa east Structure 2
Closure of DWF gate at CSO 107	Closure of DWF gate at CSO 107
Changes to 20th/Poppleton stormwater facility	Changes to 20th/Poppleton stormwater facility

Note: shading indicates components that are different in the CTS Joint Drop Shaft HPA.

3.3.2.3 Representative Year Results for Vetted HPAs

The CSO volumes and estimated capture percentages for the vetted HPAs are shown in Table 3-7. The information is also compared with the same information for the Optimization Baseline simulation.

TABLE 3-7
CSO Volumes (MG) and Volume Capture for Vetted HPAs

	CSO Outfall												
Scenario	**105**	**106/107**	**108**	**121**	**109**	**110**	**111**	**114**	**115**	**118**	**119**	**Total CSO**	**% Capture**
Opt. Baseline	275	102/107	222	33	250	1	1	2	26	174	48	**1240**	**71%**
CTS	100	86	99	29	72	1	1	2	26	174	48	**637**	**85%**
CTS JDS	100	68	133	29	57	1	1	2	26	174	48	**639**	**85%**
NTS.R3.1	98	46	143	32	68	1	1	2	26	174	48	**639**	**85%**

TABLE 3-7
CSO Volumes (MG) and Volume Capture for Vetted HPAs

	CSO Outfall												
Scenario	**105**	**106/107**	**108**	**121**	**109**	**110**	**111**	**114**	**115**	**118**	**119**	**Total CSO**	**% Capture**
NTS.R3.2	37	95	86	33	134	1	1	2	26	174	48	**636**	**85%**
NTS.R3.Ref1	97	67	145	33	150	1	1	2	26	66	48	**635**	**85%**
NTS.R3.3	95	66	144	32	164	1	1	2	26	56	48	**635**	**85%**

JDS = joint drop shaft

3.3.2.4 Focus on Three High-Performing Alternatives

Through discussions of results from the Optimization Analysis, several City preferences were identified regarding the HPAs, which are presented as follows:

- The City prefers alternatives that do not include two additional satellite RTB facilities (since a RTB at CSO 106/107 is included in all non-tunnel HPAs, the preference to have only one satellite RTB suggests that additional control would likely be achieved by a storage tank, most likely at CSO 109).
- Some HPAs would provide significant benefits for hydraulic grade line (HGL) reduction and drainage of a low spot near 11th/Izard. The City has an interest in exploring how potential CSO solutions could be integrated with alternatives that help drain this area under high-river level conditions, and that contribute to reduced HGLs at this low spot in the City.
- Having consolidated facilities at the MRWRRF site is beneficial for operations. However, building significant CSO facilities at the site within limited space will likely hinder the ability to expand treatment operations to meet future regulatory goals. Therefore, preserving space at the MRWRRF is preferred.

Table 3-8 illustrates the HPAs according to key City preferences.

TABLE 3-8
Matrix Showing City Preferences for HPAs

High-Performing Alternative	Maximum of One Satellite RTB	Preserves MRWRRF Site	Drains 11th & Izard Low Spot
CTS	Yes	Yes	Yes
NTS.R3.1	No – RTBs at CSOs 106/107 and 109	Yes	No – no major facility for CSO 108
NTS.R3.2	Yes	Yes	Yes
NTS.R3.Ref1	Yes	No – Tank for CSO 118	No – no major facility for CSO 108
NTS.R3.3	Yes	No – RTB at MRWRRF	No – no major facility for CSO 108

Of the five HPAs, only the CTS HPA and NTS.R3.2 meet all three City preferences. Focusing solution refinement and cost verification on these two HPAs, rather than all five, helped to efficiently perform the refinement and verification tasks. Other HPAs were not eliminated, and some findings (such as site suitability near CSOs 106/107) were expected to be applicable to other HPAs. However, the CTS HPA and NTS.R3.2 were most consistent with the City's objectives and were therefore selected to be the focus in the Concept and Cost Verification.

As noted previously, an additional configuration for the CTS HPA was considered; namely, a JDS located near CSOs 106/107. The CTS with JDS would convey some CSO 108 flow to a combined (joint) drop shaft that would also receive flow from CSOs 106 and 107. This would eliminate a drop shaft at CSO 108 to avoid potential conflicts with areas that are undergoing redevelopment. In addition, this configuration would help to further mitigate some HGL issues in the north downtown area near 11th and Izard Streets. It would include a slightly larger tunnel to compensate for the less efficient capture of CSO 108 flow. Thus, the two originally selected HPAs became three for Concept and Cost Verification.

3.3.3 Concept and Cost Verification

The three remaining HPAs were taken to a further level of analysis to refine the concepts and develop more accurate, site-specific, planning-level costs. Concept and Cost Verification was the third phase of the Optimization Evaluation. The objective of this evaluation was to develop comparative-level concepts and comprehensive cost estimates among the remaining HPAs to support the City in determining a path forward and developing the 2021 LTCP Update. Details of each HPA's concept and cost development are presented in High Performing Alternative Concept and Cost Verification TM, which is provided in Appendix G. The HPAs evaluated include the CTS, CTS JDS, and NTS.R3.2.

The CTS, CTS JDS, and NTS.R3.2 HPAs were revisited to further refine the concepts and develop more detailed cost estimates (Class 4). The Class 4 estimates were developed for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Class 4 estimates assume a project definition or design between 1 and 10 percent and are considered a pre-design evaluation. Typical accuracy ranges for Class 4 estimates are -30 percent to +50 percent.

Each alternative's components were evaluated and refined to account for specific site details and constraints, including revisiting and documenting design parameters and major assumptions, developing layouts for each component, incorporating design changes based on constructability reviews, and considering O&M requirements. The design parameters evaluated included: hydraulics, structural, geotechnical, excavation, pumping, control gates, odor control, tank-cleaning systems, large-diameter tunneling, microtunneling, drop shafts, RTBs, monitoring controls, screening systems, grit removal systems, and automation. Other site considerations were also screened and evaluated, including soils (where data were available), environmental screening data, utility relocation costs, power requirements, and property acquisition.

The concepts developed attempted to maintain consistency among the HPAs and to standardize some components for common elements (i.e., screens, grit management, odor control, flushing systems, and similar) because of a lack of available data that would support distinguishing differences. This Concept and Cost Verification did not involve any additional data collection or analysis needed to differentiate among HPA components for equipment selection or facility layouts. Some variations between different site landscaping and facility architectural features were warranted based on locations of facilities and proximity to adjacent properties.

The validation of the concepts included development of three-dimensional models for the more complex facilities (RTBs, tanks, grit/screening facilities, and similar) and/or the development of plan/profile/detail drawing sheets to capture representative details of each alternative's components. The various components were selected and sited based on site-specific considerations for access, construction, and long-term O&M.

The components of each HPA as included in the Concept and Cost Verification effort are summarized and illustrated below.

3.3.3.1 Collector Tunnel System High-Performing Alternative

The main component of the CTS concept is an approximately 10,000-LF, 17-foot-inner-diameter tunnel constructed entirely within bedrock (Figure 3-4). The downstream end of the tunnel would be located near the intersection of South 4th Street and Pierce Street. The tunnel would extend north, crossing under Conagra's downtown campus, Heartland of America Park, and Lewis and Clark Landing; and would terminate north of Abbott Drive, just south of the existing Grace Street ditch. This HPA includes the following components:

- Collector Tunnel and near-surface facilities (NSFs; approximately 10,000 LF,17-foot-inner-diameter tunnel). NSFs include tunnel diversions, grit and screening facilities, and tunnel drop shafts at CSO 106/107, CSO 108, and CSO 109.
- Collector Tunnel Lift Station (50 MGD lift station) near 4th and Pierce Street.
- RTB and river discharge piping (50 MGD RTB) near 4th and Pierce Street.
- CSO 105 Outfall Active Control.
- North Interceptor Inline Storage Structure #1.
- North Interceptor Inline Storage Structure #2.
- Minne Lusa East Inline Storage Structure #2.
- Grace St DWF Diversion Rehabilitation.
- 20th and Poppleton Stormwater Facility Improvements.

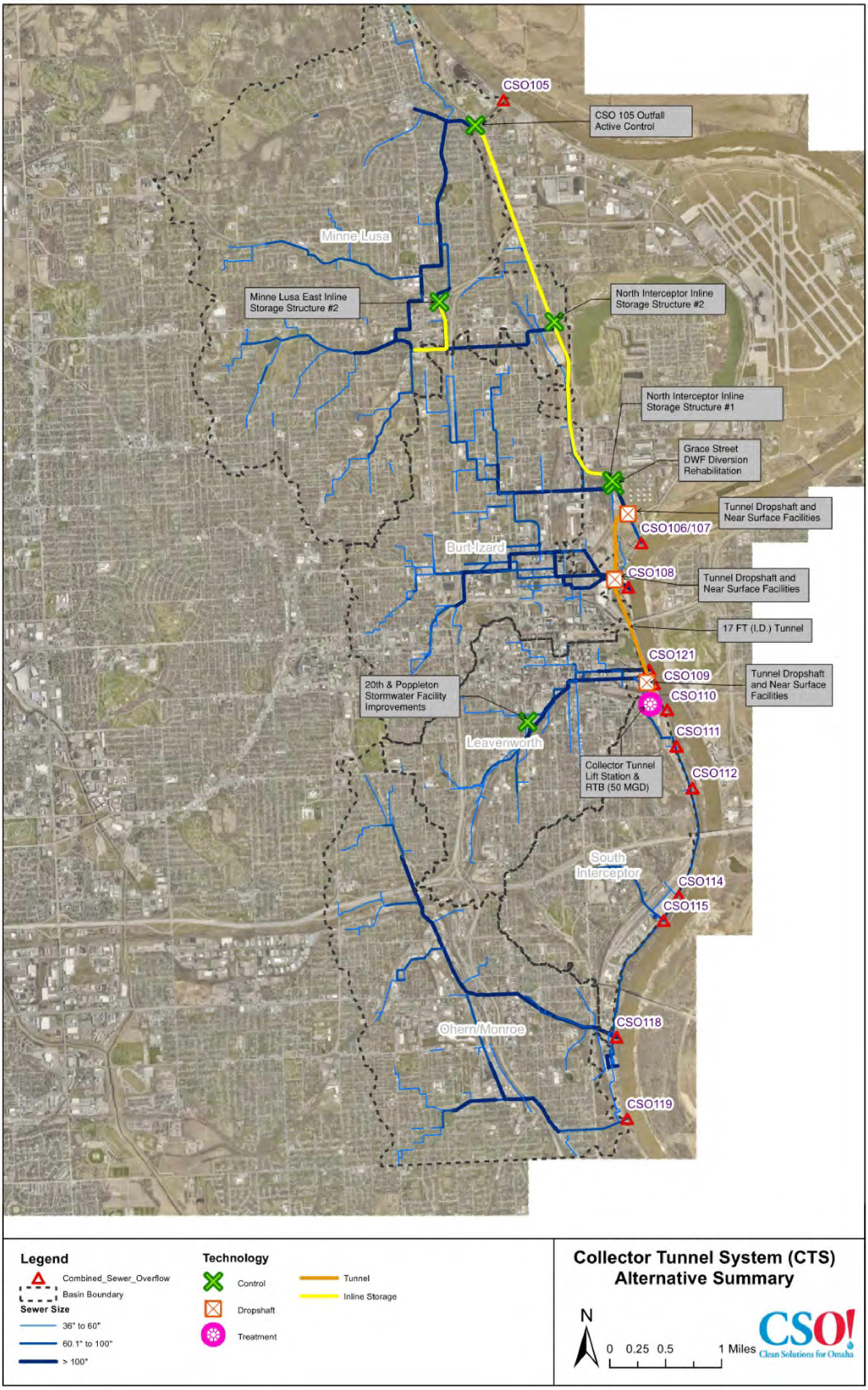

FIGURE 3-4
Collector Tunnel System High-Performing Alternative Watershed Map

3.3.3.2 Collector Tunnel System Joint Drop Shaft High-Performing Alternative

The CTS JDS HPA includes the same major components (e.g., tunnel and terminus RTB) as the CTS HPA (Figure 3-5). For this alternative, the CTS Burt-Izard (CSO 108) NSFs would be removed and replaced with active control facilities at 21st and Cuming and 11th and Izard, and a conveyance sewer from 11th and Izard would convey wet weather flows to the CTS tunnel drop shaft near CSOs 106/107 to abate CSO 108 overflows. This eliminates a drop shaft at CSO 108 to avoid conflicts with areas that are undergoing redevelopment.

Because the wet weather flow is being diverted upstream of the CSO 108 diversion, the CTS JDS HPA is slightly less effective at controlling CSO 108 overflows, and a slightly larger-diameter tunnel (17.5-foot-inner-diameter) is required. In addition, a much longer route to a drop shaft (which is the North Downtown Conveyance Sewer – 11th and Izard to 6th and Abbott) would be required to convey flows to the Collector Tunnel. This HPA includes the following:

- Collector Tunnel and NSFs (approximately 10,000 LF,17.5-foot-inner-diameter tunnel); drop shafts at CSOs 106/107 and 109
- Collector Tunnel Lift Station (50 MGD lift station) near 4th and Pierce Street
- RTB and river discharge piping (50 MGD RTB) near 4th and Pierce Street
- CSO 105 Outfall Active Control
- North Interceptor Inline Storage Structure #1
- North Interceptor Inline Storage Structure #2
- Minne Lusa East Inline Storage Structure #2
- Grace St DWF Diversion Rehabilitation
- North Downtown Conveyance Sewer – 11th and Izard to 6th and Abbott (60-inch diameter)
- 11th and Izard Grit and Screening Facility
- 11th and Izard Active Control
- 21st and Cuming Active Control
- 20th and Poppleton Stormwater Facility Improvements

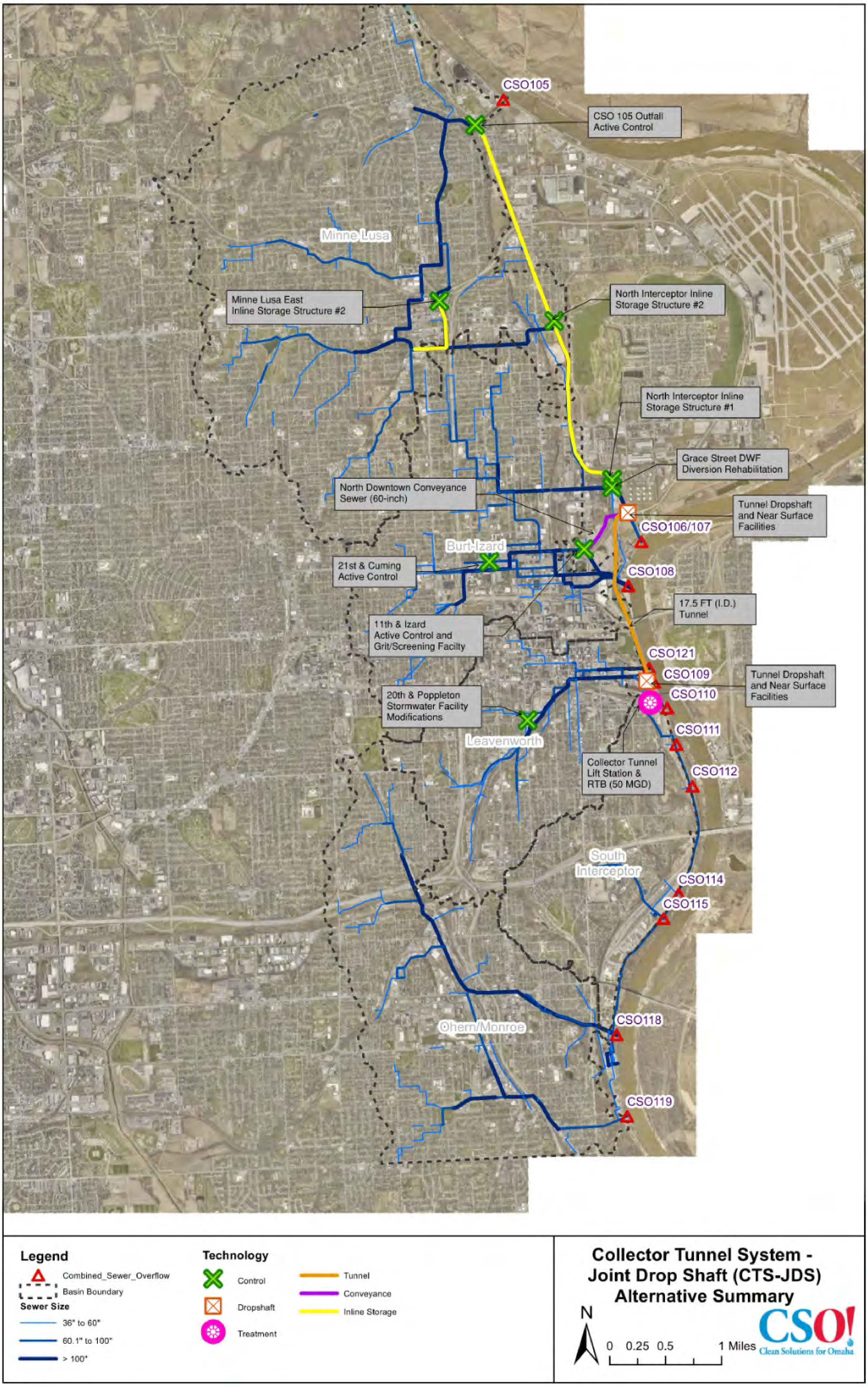

FIGURE 3-5
Collector Tunnel System Joint Drop Shaft High-Performing Alternative Watershed Map

3.3.3.3 Non-Tunnel System High-Performing Alternative

The NTS.R3.2 alternative provides CSO control through a variety of components, including treatment (RTB near CSOs 106/107) and storage (storage tank near CSO 109), and implementing active controls in the collection system to maximize the use of the RTB facility (Figure 3-6). The NTS.R3.2 HPA would provide additional CSO control at outfalls 105, 106/107, 108, and 109.

The CSO 105 active control facility would be located at the CSO diversion to control wet weather flow by directing flow downstream in the North Interceptor for treatment at the proposed RTB downstream of CSOs 106/107 (Northeast Omaha RTB – 6th Street and Abbott Drive). To accommodate treatment during high-river conditions, the proposed RTB facility includes a wet weather pump station (185 MGD). Functionally, the pump station could be located upstream (Pump-In) or downstream (Pump-Out) of the treatment facility. There are operational advantages and disadvantages to both configurations; however, to identify any cost differences, both the Pump-Out and Pump-In concepts and costs were developed; they will be referred to as “NTS Pump-Out” and “NTS Pump-In.”

The NTS.R3.2 HPA alternative includes the following:

- Northeast Omaha RTB – 6th Street and Abbott Drive (185-MGD RTB) with pump station and grit/screening
- Leavenworth Basin Storage Tank (5.5-MG storage tank)
- CSO 105 Outfall Active Control
- Minne Lusa Relief Sewer Diversion Modifications (33rd and Paxton and 31st and Sprague)
- Grace St and North Interceptor DWF Diversion Rehabilitation
- North Downtown Conveyance Sewer– 11th and Izard to 6th and Abbott (72-inch diameter)
- 11th and Izard Grit and Screening Facility
- 11th and Izard Active Control
- 21st and Cuming Active Control

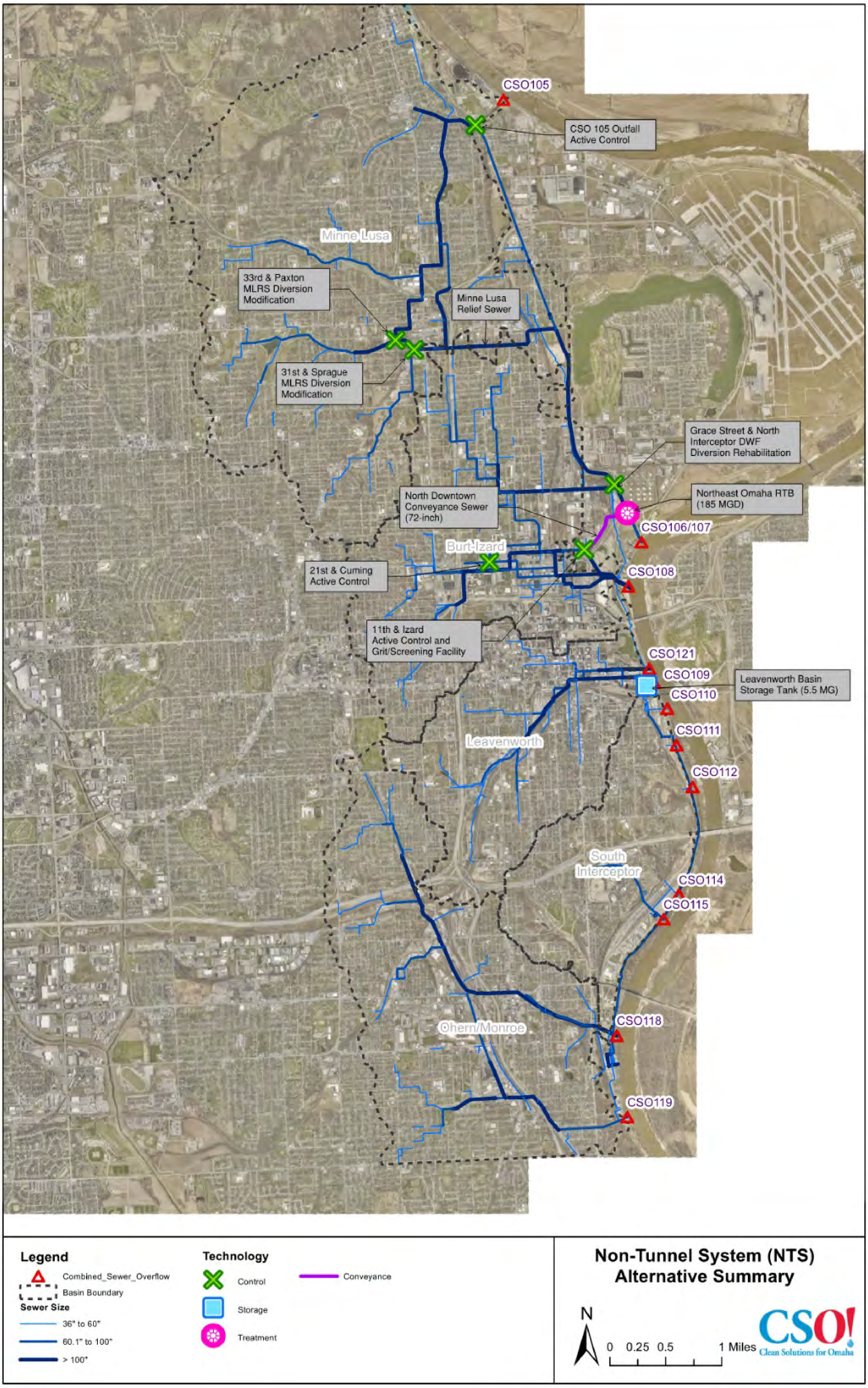

FIGURE 3-6
Non-Tunnel System High-Performing Alternative Watershed Map

Capital Cost Estimates

Construction cost estimates were developed using quantity takeoffs derived from the conceptual drawings and applying project-specific unit prices. Construction unit costs were developed using pricing from similar types of construction and projects in Omaha and around the U.S., database values, and quotes. Unit costs included markups for contractor overhead and profit, insurance, and bonds. The markups were estimated based on construction-type contract size, and past project experience. Mobilization costs were included in the construction costs and were carefully considered based on each component, and different percentages (as part of the base construction cost) were assumed. Base construction costs were developed with an allowance of 25 to 30 percent of the construction cost to account for indeterminates and material pricing uncertainty.

An environmental evaluation was conducted to identify potential environmental concerns in the vicinity of the HPA components. The details of this evaluation are presented in the Environmental Assessment of HPAs TM, dated October 12, 2020 (PMT, 2020b), which is available upon request. Additional provisions and/or costs for any identified environmental concerns were included in the cost estimates. As design progresses further, environmental assessment of each site is warranted.

Indirect design costs included professional services costs (field investigations, engineering and design, and construction management) and were estimated as a percentage of the base construction costs. Other indirect costs such as utility relocation costs and property acquisition costs were included in developing a total capital cost (base construction cost + indirect costs).

A TM was prepared to support the development of costs for property and easement acquisition, called Optimization Technical Assessments – Update of HPA Land Acquisition, Easement, and Site Development Data TM, dated October 6, 2020 (PMT, 2020c), available upon request. The property evaluations also included non-monetary evaluation criteria such as development impacts and/or future potential developments on or near the proposed sites.

The Engineering News-Record Construction Cost Index (ENRCCI) of 11397 (March 2020) was used for this cost analysis. Summaries of base construction and capital costs for each HPA are provided in Table 3-9.

TABLE 3-9
Class 4 Cost Summaries for High-Performing Alternatives (ENRCCI 11397 - March 2020)

	CTS HPA	CTS JDS HPA	NTS Pump-Out HPA	NTS Pump-In HPA
MRW % Capture	85%	85%	85%	85%
Construction Cost Estimate	Class 4	Class 4	Class 4	Class 4
Allowance for Indeterminates & Material Uncertainty	25–30%	25–30%	25–30%	25–30%
Base Construction Cost	**$290,859,000**	**$299,923,000**	**$249,142,000**	**$237,109,000**
Indirect Design Costs	$122,161,000	$126,468,000	$104,640,000	$99,586,000
Utility Relocation Costs	$2,266,000	$2,466,000	$3,408,000	$3,408,000

TABLE 3-9
Class 4 Cost Summaries for High-Performing Alternatives (ENRCCI 11397 - March 2020)

	CTS HPA	CTS JDS HPA	NTS Pump-Out HPA	NTS Pump-In HPA
Property Acquisition/Easements	$15,761,000	$17,662,000	$15,630,000	$15,630,000
Indirect Construction Cost Subtotal	**$140,188,000**	**$146,596,000**	**$123,678,000**	**$118,624,000**
Total Capital Cost	**$431,047,000**	**$446,519,000**	**$372,820,000**	**$355,733,000**

For the City's Capital Improvements Plan (CIP) and the development of Program costs discussed in Section 5, a risk contingency of 25 percent of base construction costs would be included to develop project budgets to cover potential project risks and change orders. The value of the risk contingencies for the HPAs shown in Table 3-9 would range from $59 million to $75 million and would be added to the total capital cost.

Lifecycle Cost Estimates

To account for costs related to O&M and replacement/rehabilitation, the net present values (NPVs) of lifecycle costs for the HPAs were calculated. The O&M lifecycle costs for the NTS Pump-Out and Pump-In options were assumed to be very similar and were not calculated separately. Similarly, the lifecycle costs for the CTS and CTS JDS HPAs were assumed to be very similar. A lifecycle period of 50 years commencing in 2037 was used to compare present values of the technologies analyzed. The present values in this lifecycle cost analysis were calculated with a real discount rate of 0.4 percent. The lifecycle cost analysis incorporated costs related to maintaining performance through routine and storm event O&M. The cost to operate and maintain a facility is based on costs related to labor, materials (including treatment and chemical costs), and utilities. The primary factors in these costs include energy costs, labor costs (event and routine maintenance), and treatment costs. Lifecycle costs also include equipment replacement/rehabilitation costs that occur throughout the lifecycle period. Table 3-10 presents a comparison of the total O&M lifecycle costs for the CTS and NTS HPAs.

TABLE 3-10
O&M Lifecycle Cost Summaries for the CTS and NTS.R3.2 High-Performing Alternatives

	CTS HPAs	NTS.R3.2 HPAs
NPV - Annual O&M	$133,936,000	$140,605,000
NPV - Repair & Replace	$61,716,000	$49,447,000
Total O&M Lifecycle Cost (NPV)	**$195,652,000**	**$190,052,000**

NPV = Net Present Value

The lifecycle costs for the CTS and NTS alternatives are similar because the facilities requiring regular maintenance (such as grit and screening facilities and RTBs)—and therefore the staff, chemical, and treatment costs—are similar. The types of O&M and repair requirements associated with the tunnel would require new procedures and practices to augment those the City currently has in place.

Decision Factor Analysis

A decision factor analysis was conducted to compare the HPAs. The details are presented in the Optimization Decision Factors for HPA Selection TM (PMT, 2020a), which is available upon request. The HPAs consist of different physical components; however, they are functionally similar in terms of how much wet weather volume would be controlled and the CSO outfall locations where most of the volume would be controlled. The decision factor analysis was conducted for identification and application of decision factors, adapted from the use of secondary criteria during the initial evaluations, with the intention of helping to make the final selection. The secondary criteria were grouped into six categories, listed as follows:

- Water Quality
- Remaining CSOs
- Resilience
- Long-Term Operations
- Risk
- Community Benefits

The secondary criteria previously listed evolved into decision factors. The decision factor topics for comparison of the three HPAs were as follows:

- Treatment Near the Source
- Remote Facilities
- O&M of Large Facilities
- O&M of Smaller Components
- Potential Savings or Other Advantages by Phasing HPA Components and Adaptive Management
- Impacts of Expansion for Water Quality
- Impacts of Expansion for Additional Volume Capture
- O&M Impacts to Existing Facilities
- Resilience When Operating at High River Levels
- Safety Factors
- Sensitivity Analysis

Along with the decision factors, draft O&M protocols were also prepared. The frequency and relative level of effort of required O&M activities were compared for each HPA. Because the HPAs have similar components, the qualitative comparisons for O&M requirements were similar as well. The difference was mainly related to larger size and more variable flow rates of the Northeast Omaha RTB in the NTS.R3.2 HPA compared to the smaller and more constant flow rate for the RTB in the CTS HPA. The CTS alternative would also introduce deep underground storage requiring new procedures and equipment for periodic inspection and maintenance.

Key findings of the decision factor analysis are as follows:

- The decision factor considerations did not provide a basis for overriding cost as the main decision factor.
- The most important element of the decision factor material was the comparison of the O&M requirements.
- There was some preference noted for shallower facilities since they tend to reduce construction risk, and this preference would tend to lead toward the use of the Pump-In version of the NTS.R3.2 RTB.
- Operating RTBs with more upstream storage, which will result in less dynamic and more uniform flows, is preferred.
- City staff should assess, develop, and implement a stakeholder engagement process.

Final Selection of HPA to Implement

The goal of the optimization process was to assist the City in selection of an alternative to establish CSO controls to meet water quality requirements and support the development of the 2021 LTCP Update. The City has made the decision to proceed with the NTS.R3.2 HPA due to the lower capital costs for CSO control within the MRW. Another factor was that the O&M of the NTS facilities have similar requirements to other facilities owned and operated by the City, such as the CSO 102 disinfection facility and the SCRTB (currently in construction).

As explained in further detail in Section 5, the selected NTS.R3.2 HPA consists of nine individual facilities. The nine facilities have been given the official project names listed in Table 3-11. Also included in Table 3-11 are other terms for these facilities that were used during the Optimization Evaluation, and will be encountered in Appendices E, F, and G. These facilities are illustrated on Figure 3-7.

TABLE 3-11
Facility Names for Preferred Alternatives

Official Facility Name	Other Terms Used in Optimization Evaluation
CSO 105 Outfall Active Control	CSO 105 Active Control Structure/Facility
Northeast Omaha RTB - 6th Street and Abbott Drive	185 MGD RTB (different sizes in early alternatives) RTB at CSOs 106/107; CSO 106/107 RTB; 106/7 RTB Grace Street RTB; Grace RTB

TABLE 3-11
Facility Names for Preferred Alternatives

Official Facility Name	Other Terms Used in Optimization Evaluation
Leavenworth Basin Storage Tank (CSO 109)	5.5 MG Storage Tank (different sizes in early alternatives) Tank at CSO 109; 109 Tank; 109 Storage Tank Leavenworth Storage Tank
Minne Lusa Relief Sewer Diversion Modifications	33rd & Paxton (or 31st & Sprague) (MLRS) (Diversion) Active Control MLRS Diversion(s) (Modifications) Active Weir at 31st & Sprague (or 33rd & Paxton)
Grace St and North Interceptor DWF Diversion Rehabilitation	Grace (or North Int) Gate Operation Change Grace (or North Interceptor) DWF Gate Improvements
North Downtown Conveyance Sewer - 11th and Izard to 6th and Abbott	11th & Izard Conveyance Sewer 11th & Izard Conveyance Tunnel; 11th & Izard Tunnel
11th and Izard Grit and Screening Facility	11th & Izard NSFs
11th and Izard Active Control	11th/Izard Flow Diversion
21st and Cuming Active Control	

The major investment associated with the RTB construction will not begin for a few years due to study and design of the facility, thus allowing an interim period where the City will focus on continuing to implement ongoing projects, to maximize use of the existing collection and treatment system using RTCs and other strategies, and to assess the performance of existing and new wet weather facilities. The decision to move forward with the major investment of the Northeast Omaha RTB construction will take this experience into account. This interim period will allow the SCRTB to begin operating and provide lessons learned for confirming the decision to implement the NTS.R3.2 approach or to consider the possibility of a shift to the CTS.

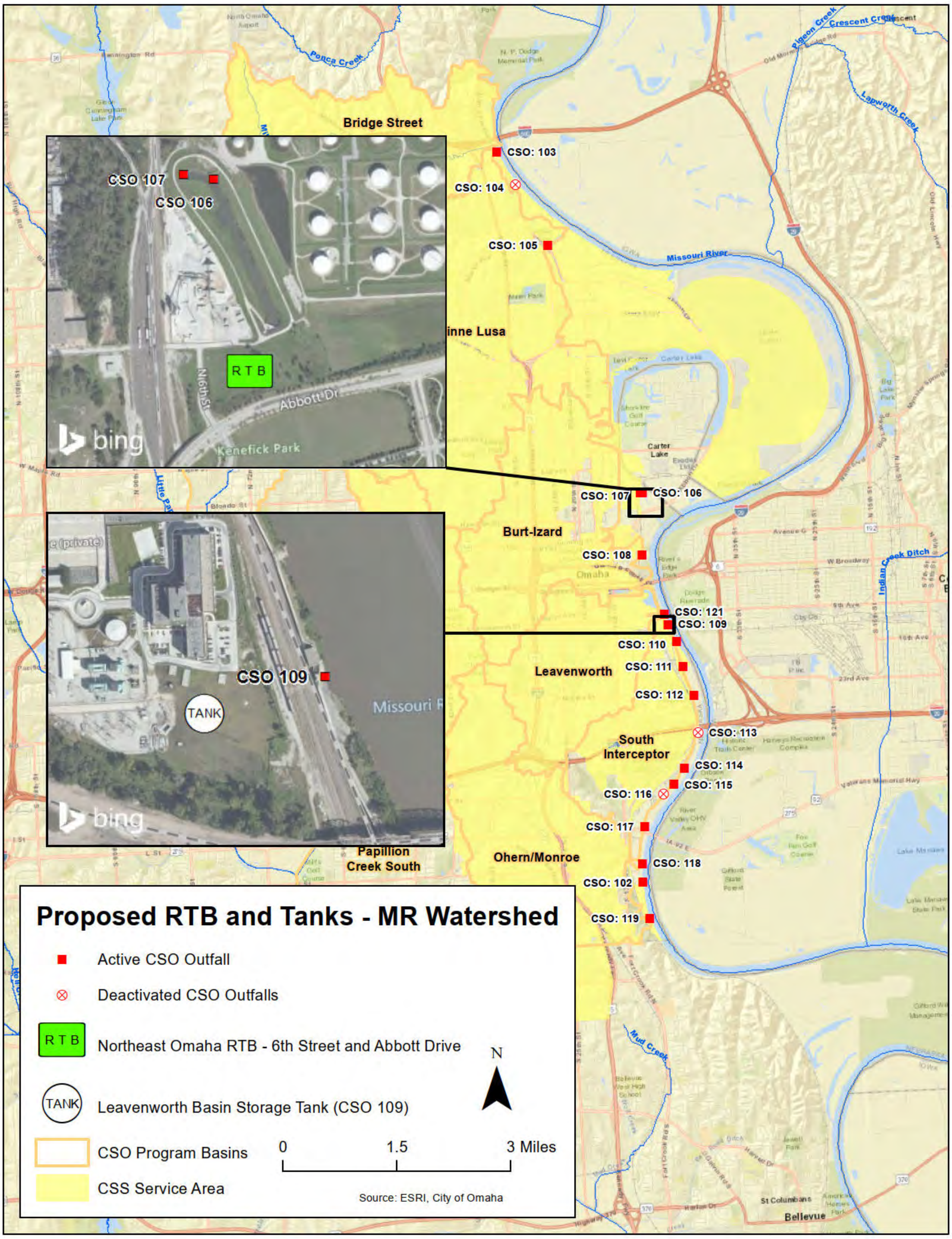

FIGURE 3-7
Facilities for Selected HPA

3.4 Other Evaluations in the Missouri River Watershed

3.4.1 CSO 103 – Bridge Street Lift Station

There were two projects that were proposed for the CSO 103 basin in the 2009 LTCP and the 2014 LTCP Update—36th Street Sewer Separation and Bridge Street Lift Station. The purpose of the 36th Street Sewer Separation project, in the CSO 103 basin, was to reduce wet weather flows that would cause an overflow from CSO 103. This project was completed in late 2014, and the City has been monitoring the CSO diversion with the intent to deactivate the outfall when monitoring data indicate it is safe to do so.

The stated intent of the Bridge Street Lift Station project was to provide additional capacity and reliability to ensure that dry-weather overflows do not occur at this location because of the proximity of the lift station to the CSO diversion. This project was included in the 2009 LTCP as a system reliability project but not as part of the LTCP project compliance schedule. The implementation of a system reliability project is as necessary and when funding is available.

Over the last 5 years, the City has continued to monitor the CSO occurrences at the CSO diversion. Any wet weather or dry-weather occurrences underwent detailed root-cause analysis, and the City recorded when maintenance or equipment failure contributed to these occurrences. Replacement of the manual bar screen with an automated one in 2017, along with improved inspection and operation of the lift station, reduced the likelihood of bar screens clogging, which had been an issue. Evaluation of the collection system and the lift station resulted in better operation of the facility. This includes significant cleaning of the pipelines that enter the lift station, flow monitoring for inflow and infiltration (I/I), and improved maintenance inspection protocols at the lift station. The flow monitoring revealed excessive I/I in the collection system, and CCTV inspection has confirmed pipeline defects that contribute to this finding.

Based on the City's evaluation of the lift station performance, flow monitoring, and infrequent CSO occurrence, the City has determined that the lift station replacement is not a project needed to meet compliance with the LTCP. Increasing the capacity of the Bridge Street Lift Station may still be necessary to handle excessive infiltration; however, a slight modification to the diversion weir, along with cleaning and inspecting the contributing system, as would be handled under the Nine Minimum Controls (NMC) Plan, is the most practical solution to prevent dry-weather overflows. Therefore, the project has been removed from the 2021 LTCP Update.

As part of the City's ongoing asset management of existing facilities, it is anticipated that the Bridge Street Lift Station will be replaced within the next 5 to 10 years outside of the CSO Program. The lift station has suffered equipment failures over the years and due to age and condition is still on a capital asset renewal project list. The gravity sewer collection system has a risk scoring model, which the City will use to determine where to further assess and rehabilitate the collection system. This effort will be completed under other City programs for rehabilitating wastewater collection systems. In addition, the City's flow monitoring program has installed a semi-permanent level monitor at the CSO weir and will be tracking this to make future decisions.

The City anticipates this CSO to remain in the next permit, while undergoing evaluation for deactivation.

3.4.2 CSO 105 – Minne Lusa Avenue – Forest Lawn Creek Inflow Removal and Outfall Storm Sewer

As presented in Section 2, the Forest Lawn Creek Inflow Removal and Outfall Storm Sewer Project was identified as a key element of the CSO Program and proposed downstream LTCP facilities were sized dependent on the removal of these flows from the CSS. The project was bid in late 2018, but because of the single high bid, it was rejected, and evaluations were performed to review the costs as described in Section 2.

The Optimization Evaluation included the Forest Lawn project as a baseline project, meaning it was assumed to be constructed. The City conducted an evaluation to determine the impact on the Optimization Evaluation's HPAs if the Forest Lawn project was not constructed. The results of the evaluation determined that to capture the additional volume of wet weather flow that the Forest Lawn project would have captured otherwise, the size of the control facilities proposed in each HPA would have to be increased. For example, the Collector Runnel would need to be increased from 17-foot diameter to approximately 20-foot diameter to control the additional volume. The cost increases estimated for upsizing the control facilities were comparable to or greater than the cost of constructing the Forest Lawn project estimated by the value engineering (VE) evaluation, described in Section 2, although the cost estimate for upsizing the HPAs did not have the same level of accuracy.

Based on the evaluation, it was recommended that the Forest Lawn project be constructed due to the cost of the project's being similar to or less than the cost to upsize other facilities to control an equal CSO volume and the project's providing additional benefits such as reducing the risk of basement backups, reducing downstream conveyance and treatment costs, and the capability to discharge flows by gravity to the Missouri River during higher river elevations without the need for pumping. The Forest Lawn project is currently under re-design to get it ready for bidding later in 2021.

3.4.3 CSO 110 – Pierce Street Lift Station and CSO 111 – Hickory Street Lift Station

New diversion structures for the Pierce Street and Hickory Street sub-basins that were constructed in 2015 as part of the new SIFM and the South Gravity Sewer to send flows to the new Leavenworth Lift Station were commissioned in April of 2020. Dry-weather flows from the basins are now conveyed to the Leavenworth Lift Station to be pumped to MRWRRF. The Pierce Street Lift Station was taken offline on April 21, 2020 and will be abandoned. The Hickory Street Lift Station is continuing to pump flows from the Martha Street sub-basin and some local flow until construction of additional improvements makes it possible to abandon the lift station. It is planned to be taken offline in mid-2022. Orifice plates have been installed in the new Pierce and Hickory diversion structures to limit flows to the Leavenworth Lift Station from these combined sewer basins since these basins were planned to be separated when the lift station was designed, to limit the flows into the station.

As part of the Optimization Evaluation, it was determined that the proposed Pierce Street and Hickory Street Sewer Separation projects are not needed to achieve 85 percent volume capture in the MRW because their overflow volumes are small. In addition, the separation projects may not be the most cost-effective means of reducing the flows to the Leavenworth Lift Station because orifice plates that have been installed are providing flow control. Monitoring of CSOs and flows to the Leavenworth Lift Station are needed to evaluate whether the changes already implemented are sufficient to provide the necessary level of flow control or whether additional evaluations are needed to identify the most appropriate type of additional flow control(s). The Pierce Street and Hickory Street Sewer Separation projects will be scheduled towards the end of the LTCP until it is determined if the projects are needed.

3.4.4 CSO 117 – Missouri Avenue Lift Station

The Missouri Avenue Sewer Separation Phase 2 project provides sewer separation for the area upstream of the Spring Lake Park Golf Course as described in Section 2. The separated stormwater from this area is sent to the detention and infiltration basins constructed within the Spring Lake Park Golf Course. After the completion of the Missouri Avenue Sewer Separation Phase 2 project, an evaluation of the CSO 117 basin was performed to determine if any additional sewer separation was needed in the Missouri Avenue sewershed. The result of the evaluation found some minor areas where additional construction was needed to complete the separation. These areas will be addressed, and the project completed by October 2021, at which point it is anticipated that the CSO 117 diversion will be closed and the CSO outfall will be converted to a stormwater outfall. No additional evaluations will be done for this sub-basin.

3.5 Papillion Creek Watershed

The City has developed a list of three guiding philosophies to help determine which future projects will need to be completed in the PCW. Those philosophies are summarized as follows:

1. Do not preclude achieving water quality standards in receiving streams because of remaining CSO discharges.
2. Use downstream sanitary interceptor capacity to maximize wet weather conveyance in the collection system without causing adverse impacts to the overall operation of the sanitary interceptors.
3. Avoid increasing flow to either Papillion Creek or Cole Creek due to storm sewer projects, even if it affects the level of service, as per the City's stormwater policy. This is to prevent adverse downstream impacts in streams.

These criteria were used in reviewing projects in the PCW, as discussed in the following sections.

3.5.1 CSO 204 – 63rd and Ames

The original control for the CSO 204 basin consisted of five sewer separation phases and a storage tank. However, challenges arose during the design for the Cole Creek CSO 204 Phase 2 project due to the escalating construction cost estimates and assessment of risks associated with the construction of deep sewers and use of trenchless technologies in a confined residential area construction corridor, resulting in the CSO 204 Phase 2 project being placed on hold. An evaluation suggested that a more cost effective solution would be to select another alignment that would avoid the deep sewers but would require purchasing and demolishing several residential properties adjacent to the existing combined sewer.

As a preparation to the 2021 LTCP Update, the City performed an evaluation of various approaches in hopes of finding an alternative that would neither require deep excavations nor the purchase of residential properties. It is currently anticipated that construction of a stormwater sewer that diverts stormwater flows off the combined system for a portion of the

CSO 204 Phase 2 project area is the best approach. In addition, changes to the existing CSO diversion such as raising the weir are being considered. These project elements could allow a reduction in wet weather flows in the combined sewer adjacent to the residential properties and a decrease in the CSO volume and frequency at a lower cost with less risk than the previously considered alternatives. As a result of the evaluation, a new project, 61st and Radial Storm Sewer, is being added to the LTCP. The City will perform some additional conceptual development of this project to verify hydraulics and constructability prior to commencing design. The City has developed a backup option, which consists of a shorter storm sewer, should it be found that the 61st and Radial Storm Sewer project has fatal flaws. Section 5 includes the details of the project concept.

The City has been actively working on improving conditions in the Cole Creek Interceptors downstream of the Cole Creek CSO basin. The east and west interceptors are on opposite sides of Cole Creek and are connected at a few locations via siphons under the creek. The interceptors have deteriorating conditions due to root intrusion and other defects. Based on modeling, rehabilitation is needed to allow for CSO 202 and CSO 203 to be deactivated. The CSO 204 Phase 1 project constructed a new portion of the east interceptor just south of Ames, and in recent years the City completed a rehabilitation project for about 6,500 feet of the east interceptor downstream of the new pipe, from Military Avenue to just south of Maple Street. The City intends to continue rehabilitation of both interceptors to improve operations and reliability. Rehabilitation of the east interceptor from just south of Maple Street to about Cass Street is planned as a new project in the 2021 LTCP Update. Rehabilitation of the west interceptor will be performed outside of the CSO Program.

The CSO 204 Storage Tank was part of the 2009 LTCP to help address CSO frequency at CSO 204, but it was not needed to achieve the wet weather percent capture. With the focus on wet weather volume capture, the tank no longer makes sense. In addition, due to the configuration of the sewer system resulting from the ongoing sewer separation, a considerable amount of separate stormwater is and will be conveyed to the outfall, and a storage tank in the originally proposed location would not be able to capture only combined sewage as originally intended. There is no need to provide storage for the separate stormwater. As a result, the storage tank project is being removed from the LTCP.

3.5.2 CSO Diversion Program

It is the City's goal to deactivate most of the CSOs in the PCW, including CSOs 202, 203, 208, 210, 211, and 212. CSOs 206, 207, and 209 have already been closed. Additionally, CSO 204 has two diversions contributing flow to one outfall location, and an interim diversion was created during the CSO 204 Phase 1 project to protect the area during construction; it is the City's goal to close one of the two original diversions and the interim diversion. The remaining diversion for CSO 204 is in the Phase 2 area and is expected to remain open due to the challenges of construction in the area, as explained previously.

For most of the CSOs yet to be closed, the City will monitor the diversion structures after completion of the associated sewer separation projects to ensure that sufficient inflow reduction was achieved. If additional inflow reduction is found to be necessary, an evaluation will be conducted to identify additional work to be performed under the Inflow and Infiltration Reduction Program, which is discussed in Section 5. If monitoring shows that the CSO diversion can be closed, changes to deactivate the CSO will be constructed, and the CSO will subsequently be identified for removal from the CSO Permit. The CSO Diversion

Program is being established as a part of this 2021 LTCP Update to provide funding to address the closure of these CSO diversions because it will occur after the monitoring period following sewer separation construction.

3.5.3 CSO 201 – Papillion Creek WRRF

Several wet weather management strategies were evaluated as part of the City of Omaha Master Plan Study for the Papillion Creek Water Resource Recovery Facility (PCWRRF). The recommended approach is based on increasing the hydraulic capacity of the existing raw sewage pump station, headworks, and grit removal to 190 MGD. Influent flows above 190 MGD would be diverted to a 4-MG storage facility if necessary. The 4-MG storage facility would include a 19-MGD pumping station, and stored flows would be routed through the raw sewage pump station and the preliminary and primary treatment processes as capacity becomes available.

A schematic flow diagram of the preferred wet weather management alternative is shown on Figure 3-8, which shows the operation of PCWRRF for handling peak wet weather flows above 190 MGD. The proposed wet weather management improvements are shown in red boxes with the flows handled by the major components of the wet weather management facilities. The major components of the proposed wet weather management facilities include the following:

- Influent diversion structure
- 19-MGD wet weather pump station (if needed in the future)
- Wet weather storage (4 MG) (if needed in the future)
- Additional grit chambers
- Head box and hydraulic channel improvements
- Primary effluent diversion structure

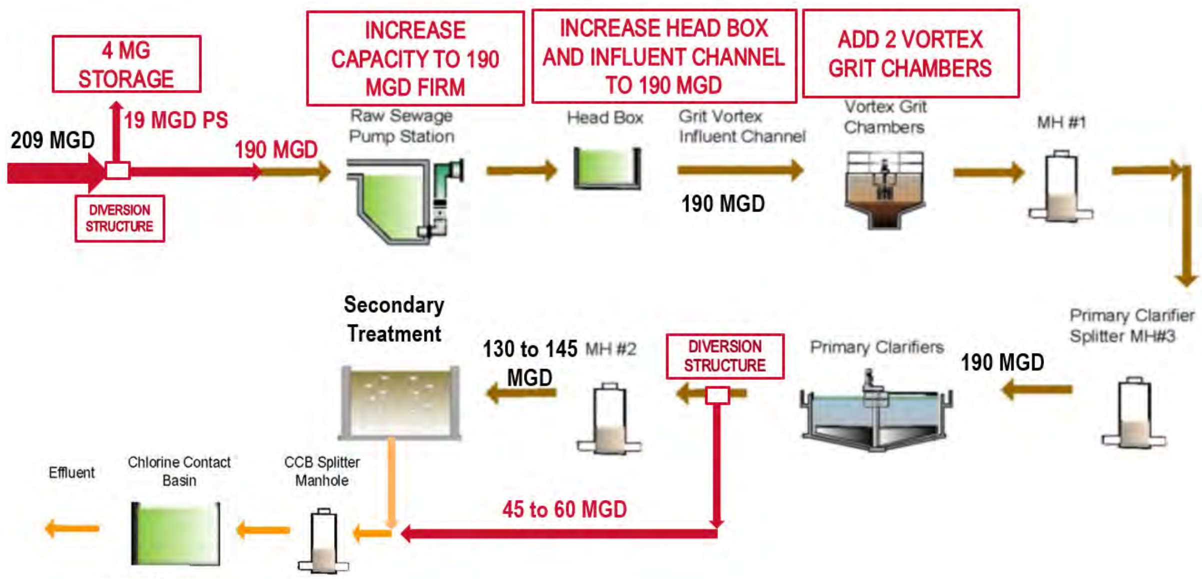

FIGURE 3-8
Schematic Flow Diagram of the Wet weather Management Facilities for PCWRRF

The City has expressed a preference to implement wet weather improvements for flows above 190 MGD only when and if needed toward the end of, or possibly beyond, the planning period of 2040. The City will be conducting selective sewer separation and I/I reduction in the PCWRRF service area in an attempt to reduce peak flows. It will take some time to assess the impacts of these efforts. However, increasing raw sewage pumping and grit removal will be completed earlier in the planning period to provide capacity for up to 190 MGD. The 19-MGD wet weather pump station and 4-MG storage facility will be constructed only if flows are expected to exceed 190 MGD. The WRRF in its current configuration has handled peak wet weather flows of about 130 MGD; dry-weather flows currently average around 60 MGD.

3.5.4 CSO 211 Inflow Reduction, CSO 210 Inflow Reduction, and CSO 204 Phase 5

The City has decided to remove the CSO 211 Inflow Reduction, CSO 210 Inflow Reduction, and CSO 204 Phase 5 projects and replace these with an Inflow and Infiltration Reduction Program. The basis of this is discussed following.

CSO 210 Inflow Reduction and CSO 211 Inflow Reduction

The CSO 210 and CSO 211 Inflow Reduction projects in the 2009 LTCP and 2014 LTCP Update were placeholders for possible future projects, if necessary, to eliminate inflow so that the outfalls could be closed. The concept was that the projects would involve the rehabilitation of sewers and implementation of other inflow reduction techniques needed to deactivate the CSOs. These projects are not needed to achieve the 85 percent volume capture requirement; therefore, they will not be included in the 2021 LTCP Update. However, it is still the City's intent to deactivate these outfalls. Any inflow reduction needed will be performed under the City's new Inflow and Infiltration Reduction Program described in Section 5.

CSO 204 Phase 5

The Cole Creek CSO 204 Sewer Separation project is comprised of multiple phases. As part of the CSO 204 Phase 1 project, a conceptual design of the entire area was performed, which resulted in a modification of the conceptual plan in the 2009 LTCP, reducing it from nine phases to six phases, with CSO 204 Phase 5 consisting of inflow reduction, as needed. This project was also a placeholder to be used if necessary. This project is not needed to achieve the 85 percent volume capture requirement and therefore, it will not be included in the 2021 LTCP Update. It is the City's intention to deactivate one of the two CSO diversions that contribute flow to the CSO 204 Outfall, which was not part of the 2009 LTCP or 2014 LTCP Update but is believed to be possible based on information learned during recent design efforts. The remaining diversion for CSO 204 is associated with the CSO 204 Phase 2 area, which was discussed previously and is expected to remain open as originally planned. Any additional inflow reduction needed will be performed under the City's new Inflow and Infiltration Reduction Program described in Section 5.

3.6 Update of the Cost – Performance Analysis

As noted in the Consent Order, the goal of the controls has been to achieve compliance with the EPA CSO Policy through the Presumption Approach, which is defined in the Policy as:

> "Presumption Approach
>
> A program that meets any of the criteria listed below would be presumed to provide an adequate level of control to meet the water quality-based requirements of the Clean Water Act (CWA), provided the permitting authority determines that such presumption is reasonable in light of the data and analysis conducted in the characterization, monitoring, and modeling of the system and the consideration of sensitive areas described above. These criteria are provided because data and modeling of wet weather events often do not give a clear picture of the level of CSO controls necessary to protect WQS.

……

> ii. The elimination or the capture for treatment of no less than 85 percent by volume of the combined sewage collected in the CSS during precipitation events on a systemwide annual average basis."

The 2009 LTCP targeted two aspects of the Presumption Approach included in the EPA CSO Control Policy: namely, no more than four overflows in the representative year, and a minimum of 85 percent wet weather volume capture. In the 2014 LTCP Update, more emphasis was placed on the volume capture requirement than the number of overflows. The CSO controls presented in this 2021 LTCP Update are focused solely on the 85-percent volume capture criterion in the Presumption Approach. This evolution to focusing on this less conservative criterion is made possible in part by the development of the more detailed hydraulic model for the collection system along with the development of a more sophisticated water quality model. As explained in Section 5, these models demonstrate that 85 percent wet weather volume capture will result in compliance or non-preclusion of compliance with water quality standards. For the MRW, the sole focus on 85 percent volume capture has resulted in significant changes to the CSO controls and a significant reduction in estimated costs. These modifications assist the City in reducing the predicted high economic burden on portions of the Omaha community, though future modifications to the implementation of CSO controls may still be required. Such modifications could take the form of schedule changes, project cost controls, alternative sources of funding, and/or changes to the ultimate level of control. For the PCW, most of the CSO controls were not changed since the 2014 LTCP Update.

3.7 Summary and Conclusions

This section provides a summary of the evaluations of updates to the CSO controls. The City has made significant progress on the implementation of the LTCP projects, and it has become apparent that the costs of the remaining controls will be comparatively high because of the fact that the more cost effective projects in terms of wet weather volume capture and *E. coli* reduction have already been implemented.

For the MRW, the City re-evaluated the remaining CSO controls to determine whether those projects were still the best projects to achieve the 85 percent wet weather volume capture required in the EPA CSO Control Policy. As noted in the previous discussion, this began in 2016 with an evaluation of the Minne Lusa CSO controls. In 2018, the City began an Optimization Evaluation to determine the best way to achieve the 85 percent wet weather volume capture in the MRW. The outcome of the evaluation was to eliminate the DTS, which was in both the 2009 LTCP and the 2014 LTCP Update. In addition, several other projects were eliminated in the MRW. These include the following:

- Webster and Nicholas Phase 2 Sewer Separation
- Storage Tanks at CSOs 105, 118, and 119
- 18th and Seward Sewer Separation (construction of the Nicholas Street Phase 3 project achieved sewer separation in this area and eliminated the need for this project)
- DTS Projects

These have been replaced by the following CSO controls:

- Northeast Omaha RTB - 6th Street and Abbott Drive (185-MGD RTB)
- Leavenworth Basin Storage Tank (CSO 109; 5.5-MG storage tank)
- CSO 105 Outfall Active Control
- Minne Lusa Relief Sewer Diversion Modifications
- Grace St and North Interceptor DWF Diversion Rehabilitation
- 11th and Izard Active Control
- North Downtown Conveyance Sewer - 11th and Izard to 6th and Abbott
- 11th and Izard Grit and Screening Facility
- 21st and Cuming Active Control

As part of the Optimization Evaluation, the Forest Lawn Creek Inflow Removal and Outfall Storm Sewer was re-evaluated, and a decision was made to move forward with the project. The project is currently under re-design and construction should begin by 2022.

Additionally, it was determined that prior to the start of the Hickory Street or Pierce Street Sewer Separation projects, a further evaluation is needed. They have been found to be unnecessary to achieve 85 percent wet weather volume capture. This evaluation will occur over the next 5 years with a project being proposed if needed in the 2026 LTCP Update.

For the PCW, the majority of the CSO projects are under design or construction. However, there were a few CSO outfalls for which the City performed evaluations to determine the best path to move forward. These included the following:

- CSO 201 – As part of the WRRFs Master Plan project, an evaluation was performed to determine what, if any, additional controls were needed to address CSO 201. The result of the evaluation was to increase the hydraulic capacity of the PCWRRF to handle 190 MGD, and up to 209 MGD if necessary. The need and timing for this project is dependent on the outcome of the City's efforts to reduce I/I in the PCWRRF service area.
- CSO 204 – The City performed an evaluation of various approaches to address the concerns associated with CSO 204 Phase 2. As a result, the City developed a concept for an alternative approach that consists of the construction of the 61st and Radial Storm Sewer, which will pull some of the stormwater off the CSS and divert it to Cole Creek.
- Cole Creek Interceptor – one of the outcomes of the evaluation of the CSO 204 area was the development of projects to rehabilitate the east and west branches of the Cole Creek Interceptor. Because the east branch has the potential to impact the ability to deactivate CSOs 202 and 203, the rehabilitation of the east interceptor will be included in the LTCP.
- CSO Diversion Program – This original project was in the 2009 LTCP to address the closing of the Cole Creek CSO diversions. It has been modified to a program to include closure of all the Papillion Creek CSO outfalls that have not yet been closed but are intended for closure, as well as CSOs 103 and 112. This will allow for the deactivation of the diversions after monitoring and any needed inflow reduction.
- CSO 211 Inflow Reduction, CSO 210 Inflow Reduction, and CSO 204 Phase 5 – The City has determined that these projects should no longer be included in the LTCP, as they were placeholders. The City replaced these projects with an Inflow and Infiltration Reduction Program.

Both the Missouri River and Papillion Creek Watershed revised projects are defined in Section 5.

4 Program Financing and Financial Considerations

4.1 Introduction

The purpose of this section is to meet the requirements of Part V. E. Cost/Performance Considerations of the City of Omaha's (City's) combined sewer overflow (CSO) permit. As noted in Table 1-1 of the Long Term Control Plan (LTCP) Update, this section requires:

"The City of Omaha shall submit a financial report to the NDEE by March 31, 2021; that sets forth a strategy to obtain sufficient revenue to fund the CSO Program through at least the year 2024 that includes funding for the specific projects in the Implementation Schedule, Section 7 of the LTCP (see also Update to 2014 LTCP)"

This section and its contents shall serve as the financial report provided to meet this permit submittal requirement. Included in the section is information on the following:

- The current status on the CSO Program's overall expenditures, to date and estimated for the future, and cost savings measures that have been implemented in order to keep the overall costs as low as possible
- Financing the program, including information on the use of loans and grants
- Program affordability and ratepayer assistance

4.2 Current Program Costs and Cost Savings Measures

The information in this section is described in greater detail in other sections of the LTCP document. This brief synopsis is included for completeness of this section.

Through February 2021, the City has paid $758 million to implement the LTCP. Approximately $477 million of this amount has been spent directly on the construction of projects. The City has awarded, or is currently bidding, more than $598 million in construction contracts, and nearly 90 percent of that contracted amount has been successfully won by local Omaha general contractors. Another $131 million in construction value is currently under design.

The current overall cost of the program, including contingencies, is approximately $2 billion, in escalated dollars through the completion date of 2037, as explained in Section 5.4 of this 2021 LTCP Update. As part of the Technical Assessment for Cost Savings (TACS) evaluation, along with the Program Optimization Evaluation that was discussed in Section 3 of this document, an overall savings of more than $500 million dollars has been achieved in comparison to the highest estimated cost of the program, which occurred in 2016, prior to the initiation of the cost savings measures.

4.3 Program Financing

The City of Omaha operates a regional wastewater collection and treatment system that serves a population of over 700,000 residents. The regional system supports a customer base that includes over 1,000 commercial and industrial customers within the City limits, and a number of outside communities in the Metro Omaha area. Omaha finances the operations and maintenance of its regional wastewater collection and treatment system through user fees that are paid for by the customers served by the system. The funds are maintained within the Sewer Revenue Fund, an enterprise fund managed by the City's Finance Department.

The City uses bond funding to pay for a portion of the capital improvements needed for the upkeep and expansion of the system, to continue to meet the demands of the regional system. In general, the City of Omaha Finance Department purchases bonds on a periodic basis, obtaining best rate available on the municipal bond market at the time of the sale. The use of bonds has allowed the City to spread out the costs over a number of years, reducing the burden on the current ratepayers.

Besides the sale of municipal bonds to finance the program, the City has taken advantage of low interest loans through the State Revolving Fund (SRF) Loan program from the Nebraska Department of Environment and Energy (NDEE). The City obtained SRF loans for the construction of a portion of the Missouri River Water Resource Recovery Facility (MRWRRF) Improvements project, specifically SRF loans in the amount of $70 million: $55 million for the second construction contract, Schedule B1[1] and $15 million for third and final construction contract Schedule B2.

In 2018, the City entered into a Water Infrastructure Finance and Innovation Act (WIFIA) loan agreement, which allowed the City to borrow up to $69.7 million for the Saddle Creek Retention Treatment Basin (SCRTB) project. This loan was the second of its kind in the U.S. At the time that the City made the decision to apply for and subsequently accept the WIFIA loan, it was believed that it might lead to a substantial cost savings for the City, however the terms of the loan at the time of closing were not as favorable as was anticipated earlier in the process. At the present time, the City is looking for alternatives to the current financing structure for the SCRTB. This could include a refinancing option that is available through the WIFIA program.

FIGURE 4-1
Former USEPA Administrator Scott Pruit, NDEE Director Jim Macy, and representatives from the City of Omaha and CSO Program Management Team congratulating Omaha on the WIFIA Loan

The City has been able to capitalize on a number of grants to help offset the costs of the program, including in the earlier years of the program grants from the Nebraska Environmental Trust (NET), which paid for portions of the work in Spring Lake Park (CSO Missouri Ave Phase 1 project) and the Westlawn-Hilcrest Cemetery area wetland (Bohemian Cemetery Project). Other smaller grants from the Papio-Missouri River Natural Resources District (PMRNRD) helped provide urban fish habitat at Fontenelle Park Lagoon and Hanscom Park Lagoon.

[1] As described in Section 2, the MRWRRF Improvements project construction was under three contracts, Schedule A, Schedule B1, and Schedule B2.

The Nebraska Department of Natural Resources (NDNR) through the Water Sustainability Fund Grant has awarded a total of $6,892,611 to the CSO Program since 2016. This award is provided to the City on an annual basis and includes approximately 10 percent of the appropriated funds statewide. It is anticipated that this award will continue annually at this amount until the completion of the LTCP.

In the fall of 2020, The City was able to take advantage of the favorable interest rates on the municipal bond market and issue refunding (refinancing) for a substantial portion of the outstanding debt in place for the financing of the Sewer Revenue Fund. Through this process the City was able to maintain its Favorable AA bond rating with the rating agencies.

Appendix H is the Operating Statement that was compiled as a part of the refinancing of bonds in the fall of 2020. That document includes a substantial amount of information related specifically to the Sewer Revenue Fund, and in addition includes a copy of the City's Certified Annual Financial Report for 2019, which is the most current report available at the time of compilation of this document.

4.4 Affordability, Current Sewer Rates, and Ratepayer Assistance

In the 2014 LTCP Update, it was estimated that continued annual increases of about 9 percent per year into the future would be necessary to fund the LTCP and other foreseeable wastewater collection and treatment expenses through 2027. This projection was well in advance of any detailed planning efforts related to capital costs that may be necessary outside of the CSO Program. Prior to the 2014 LTCP Update, the University of Cincinnati Economic Center completed a Financial Capability Assessment (FCA) for Omaha's wastewater enterprise fund. The report at that time indicated that the anticipated rate increases could lead to increases that could result in the entire City being at a "High Burden", which at that time of that report meant that a typical wastewater bill consumed 2 percent or more of the median residential household income.

The City's practice has been to establish sewer rates periodically, at either 4- or 5-year intervals. The current ordinance, approved in 2018, established sewer rates for the years 2019 to 2023. Due to some of the early cost savings measures taken by the program starting in 2016, along with more favorable financial conditions, the City was able to avoid the 9 percent annual rate increases that were previously assumed, and the current rates are escalated annually from 2019 through 2023 at 5.25 percent. Even with the reduction in the rate of increase, the typical residential household has seen a wastewater bill that averaged less than $10.00/month in 2006 rise to about $60/month in 2021.

Stantec Consulting was employed by the City to not only provide the detailed rate study that lead to the rates established under the current rate ordinance, but also to update an Affordability Study for the City. The information from the Stantec Study in 2017 was utilized in the negotiations with the NDEE for the modification of the Consent Order in 2018. The Stantec Affordability study provided information that indicated which specific areas of the City were more heavily burdened then others by sewer rates. In general, that study reiterated information that showed that when looking only at the burden in relation to the City's overall median household income, significant portions of the City are heavily burdened by sewer rates.

The City established a ratepayer assistance program during the early years of the CSO Program to assist residential households that were faced with the rising costs of utility bills, specifically for the sewer bills. During this time sewer rates, which had remained stagnant for over a decade, were escalating at double digit annual increases. The program provides assistance to low and fixed-income residential households who apply for and qualify the Low-Income Heat and Energy Assistance Program (LIHEAP) through the State of Nebraska. By partnering with an existing program, Omaha was able to keep administrative costs at a minimum and provided the maximum benefit to those who need it. A total of $14,346,000 in assistance has been provided from inception (May 2011) through December of 2020. This overall total includes additional funding from the federal Coronavirus Aid, Relief, and Economic Security Act (CARES) act that provided for additional relief for utility bills for those that were unable to pay the bills during the pandemic.

4.5 Summary and Conclusions

The City of Omaha will continue to utilize all means available to maintain sewer use fees at the lowest possible cost to its customer base while ensuring that adequate funding exists to provide for the proper operations, maintenance, and necessary improvements of the wastewater collection and treatment system. The City has continued to maintain its high AA bond rating and has taken advantage of the current financial conditions that exist to help reduce the burden of the increasing financial needs of the wastewater collection and treatment system. The City has a well-established ratepayer assistance program and will continue to address the needs of low- and fixed-income ratepayers who have difficulty paying the rising costs of utility bills.

5 Updated CSO Controls

5.1 Introduction

This section describes the updated combined sewer overflow (CSO) controls included in this 2021 Long Term Control Plan (LTCP) Update to improve water quality in the Missouri River and Papillion Creek Watersheds.

This section includes a list of controls for each watershed and identifies controls that have changed compared with what was planned in the 2009 LTCP and 2014 LTCP Update. It also provides a discussion of the expected water quality improvements and control level after full implementation of the controls. This 2021 LTCP Update is based on the results of the alternatives evaluation described in Section 3, Evaluation of Alternatives. The operational strategies for the controls discussed in this section are included in the updated Section 8, Post Construction Monitoring Plan and Section 9, Wet Weather Operations Plan.

5.2 Compliance with CSO Control Policy, CSO Permit, and Consent Order

This section specifically provides the information that is required by the City of Omaha's (City's) CSO Permit, the United States Environmental Protection Agency (EPA) CSO Control Policy, and the City's Consent Order as follows:

From the CSO Permit:

> Part V.D. Evaluation of Alternatives – "Any significant changes or revisions to the controls set forth in the LTCP and a final projects list in the LTCP shall be submitted by March 31, 2021, to the NDEE for review and approval according to the Part IX (F) Revisions to the Long Term Control Plan."
>
> Part IX.F. Revision of the Long Term Control Plan (LTCP) – "The LTCP may require revision to reflect new information, new technology, or other changes that become evident during the LTCP implementation process. Proposed significant revisions to the LTCP shall be submitted by March 31, 2021, for review and approval by the NDEE.

> Significant revisions to the LTCP generally means modification of the major CSO projects and milestone dates in Chapter 7, Implementation Schedule, of the LTCP."

In addition, paragraph 28 of the Amended Consent Order (dated October 7, 2019), states in part:

> "IT IS FURTHER ORDERED that the LTCP of 2014 shall be revised and submitted to NDEE on or before March 31, 2021 for review and approval. The amended LTCP shall address the above changes.[1] The revision shall be subject to, and contingent upon, approval by NDEE. Upon approval by the NDEE the LTCP shall be performed by the City according to its terms and schedule as implemented through the City's NPDES permits."

As stated previously the CSO controls in this LTCP were developed using criteria from the EPA CSO Control Policy, specifically the Presumption Approach (EPA, 1995a) for addressing CSOs, which states:

> "The elimination or the capture for treatment of no less than 85% by volume of the combined sewage collected in the combined sewer system (CSS) during precipitation events on a system-wide annual average basis."

Also, this section meets the requirements in the CSO Permit, which states:

> "Part VII. Statement of LTCP Compliance Objective
>
> The compliance objective of the LTCP is that the City of Omaha shall eliminate or capture for treatment no less than 85% by volume of the combined sewage collected in the Omaha combined sewer system, during precipitation events on a system wide annual average basis. The capture for treatment or elimination of 85% of the combined sewage will be determined after completion of all LTCP projects and is not required during this permit term."

Section 5.3 provides a summary of CSO controls that meet the requirements of the EPA CSO Control Policy and CSO Permit. Section 5.4 discusses the costs of the controls. Section 5.5 provides the results from the CSO hydraulic model that show that the CSO controls achieving the 85 percent capture criterion will be met during a representative year. It also provides the results from the water quality model that project that the *E. coli* standard will be met on the Missouri River and that the controls will not preclude the streams from meeting the standards in the Papillion Creek tributaries.

5.3 Updates to CSO Projects

The following tables are lists of CSO control projects by basin along with detailed information on the controls. The tables also include what the controls consisted of in the 2009 LTCP and the 2014 LTCP Update for comparison. Projects include completed projects, current projects, new projects identified during the development of this LTCP Update, and projects that have been removed from the LTCP. CSO study basins are shown on Figure 5-1, with basins highlighted where controls have been updated under this 2021 LTCP Update.

[1] The "changes" referred to is the change in the Consent Order for the City to complete the implementation of the LTCP on or before October 1, 2037.

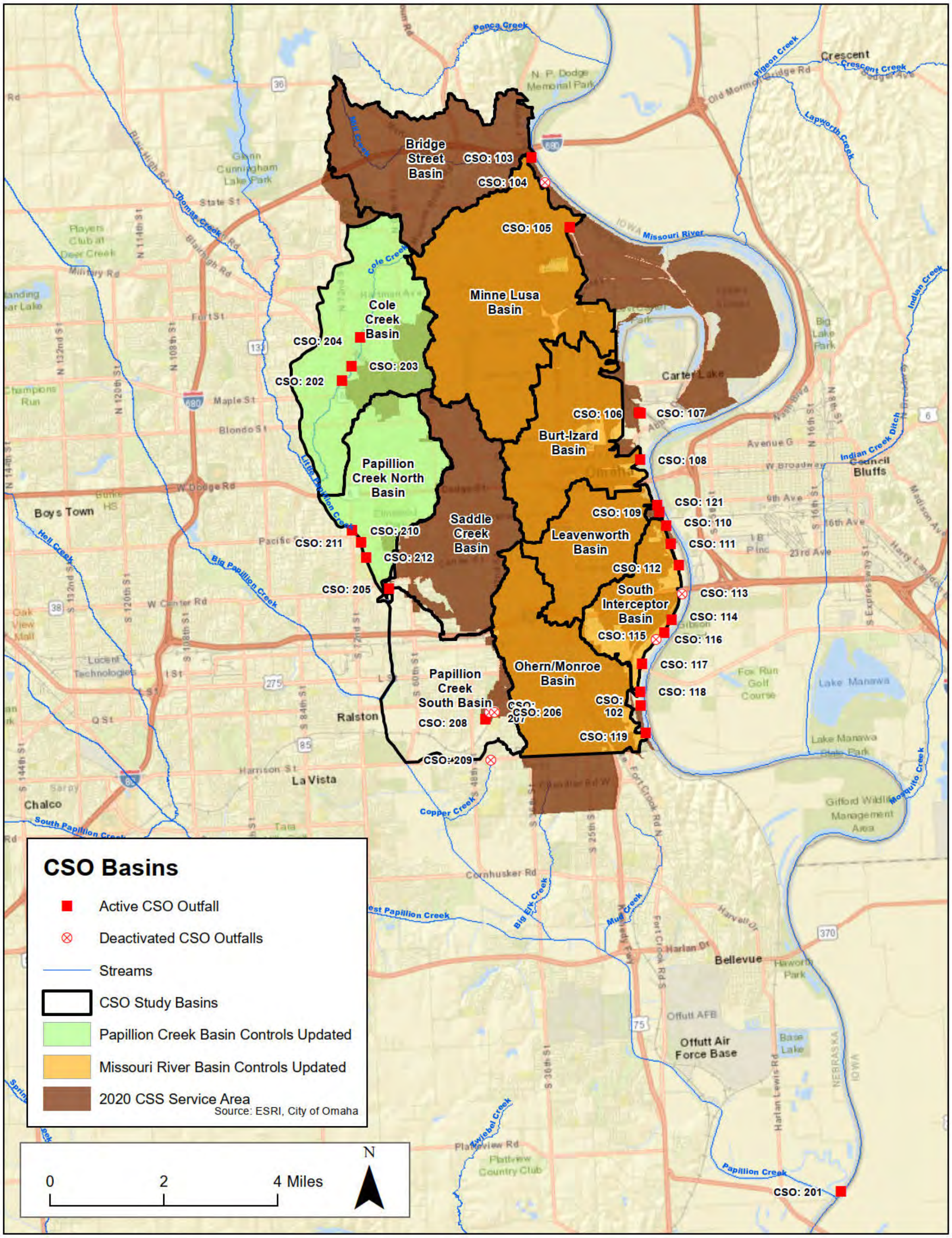

FIGURE 5-1
CSO Basins

Table 5-1 summarizes the changes in CSO control projects among the 2009 LTCP, 2014 LTCP Update, and 2021 LTCP Update that are planned in the Missouri River Watershed (MRW), which include the components of the revised plan discussed in Section 3. Table 5-2 provides technical information on those projects. Likewise, the Papillion Creek Watershed (PCW) control changes are summarized in Table 5-3, with technical information included in Table 5-4. Section 9 addresses operation of the projects, along with the Wet Weather Operations Plan, which is in Appendix B.

Missouri River Watershed

TABLE 5-1
Updated Summary of CSO Control Projects in the Missouri River Watershed

Basin	CSOs Impacted	2009 LTCP Sewer Separation Area (Acres)	2009 LTCP Projects	Changes in 2014 LTCP Update	Proposed Changes in 2021 LTCP Update
Bridge Street	CSO 103	36	Replace Bridge Street Lift Station	No changes proposed	PROJECTS REMOVED: • Bridge Street Lift Station • Parallel force main
			Construct parallel force main		
			Deactivate CSO 103 – Bridge Street Lift Station outfall		
Minne Lusa	104, 105, 106, and 107	2,234	Construct two phased storage tanks as part of a single facility:	Changed storage tank concept to a single 4.0-MG tank facility to be constructed later in the CSO Program schedule	PROJECTS REMOVED: • Storage Tank at CSO 105 • Minne Lusa Stormwater Tunnel • CSO Deep Tunnel
			Phase 1 = 1.0 MG	Sewer separation area reduced to 1,629 acres because of removal of projects	PROJECTS ADDED: • CSO 105 Outfall Active Control • Northeast Omaha RTB (185 MGD) • Minne Lusa Relief Sewer Diversion Modifications • Grace St and North Interceptor DWF Diversion Rehabilitation
			Phase 2 = 2.7 MG	Increased diameter of stormwater conveyance sewer to 14 feet	
			Deactivate CSO 104 – Mormon Street outfall	Floatables controls will be addressed with the construction as part of the CSO 105 – Minne Lusa Avenue Tank	

TABLE 5-1
Updated Summary of CSO Control Projects in the Missouri River Watershed

Basin	CSOs Impacted	2009 LTCP Sewer Separation Area (Acres)	2009 LTCP Projects	Changes in 2014 LTCP Update	Proposed Changes in 2021 LTCP Update
Minne Lusa (cont.)	104, 105, 106, and 107 (cont.)		Construct 12.5-foot-diameter stormwater conveyance sewer and associated collector sewers		
			Construct CSO Deep Tunnel Drop Shaft Complex for CSOs 106 and 107		Floatables controls will be addressed by the Northeast Omaha RTB and CSO 105 Outfall Active Control
			Install floatables control at CSO 105 – Minne Lusa Avenue outfall		
Burt-Izard	108	472	Construct CSO Deep Tunnel Drop Shaft Complex	Sewer separation acres increased to 556 based on project changes	PROJECTS REMOVED: CSO Deep Tunnel
			Implement modifications to Burt-Izard Lift Station		PROJECTS ADDED: • North Downtown Conveyance Sewer - 11th and Izard to 6th and Abbott • 11th & Izard Grit and Screening Facility • 11th and Izard Active Control 21st and Cuming Active Control
Leavenworth	109, 121	None	Construct CSO Deep Tunnel Drop Shaft Complex	No changes proposed	PROJECTS REMOVED: CSO Deep Tunnel
			Install diversion gates at Jones Street Diversion Structure	Floatables controls will be addressed with the construction of CSO Deep Tunnel Drop Shaft	PROJECTS ADDED: Leavenworth Basin Storage Tank (5.5-MG storage tank)
			Construct new Leavenworth Lift Station		Floatables controls will be addressed with the Leavenworth Basin Storage Tank

TABLE 5-1
Updated Summary of CSO Control Projects in the Missouri River Watershed

Basin	CSOs Impacted	2009 LTCP Sewer Separation Area (Acres)	2009 LTCP Projects	Changes in 2014 LTCP Update	Proposed Changes in 2021 LTCP Update
Leavenworth (cont.)	109, 121 (cont.)		Install floatables control at CSO 109 – 1st and Leavenworth and CSO 121 – Jones Street outfalls		
South Interceptor	(CSOs 110 to 117)	776	Construct CSO Deep Tunnel Drop Shaft Complex	CSOs 112 and 117 are planned to be deactivated with sewer separation and completion of Martha to Riverview sewer	PROJECTS REMOVED: CSO Deep Tunnel
			Abandon Pierce Street and Hickory Street lift stations and route flow to new Leavenworth Lift Station, along with flow from Martha Street	Route flow from the Martha Street area to new Riverview Lift Station instead of Leavenworth	PROJECTS CHANGED: Replacement of Martha to Riverview Phase 2 sewer with Blake St Lift Station Project
			Deactivate CSO 113 – Spring Street Lift Station		Floatables controls will be addressed by the Riverview Lift Station.
			Abandon Spring Street Lift Station and route flow to CSO 114 – Grover Street		
			Replace Riverview Lift Station		
			Install floatables control at outfalls for the following CSOs:		
			110 – Pierce Street Lift Station		
			111 – Hickory Street Lift Station	Floatables controls will be addressed with the construction of CSO Deep Tunnel Drop Shaft	
			112 – Martha Street		

TABLE 5-1
Updated Summary of CSO Control Projects in the Missouri River Watershed

Basin	CSOs Impacted	2009 LTCP Sewer Separation Area (Acres)	2009 LTCP Projects	Changes in 2014 LTCP Update	Proposed Changes in 2021 LTCP Update
South Interceptor (cont.)	(CSOs 110 to 117) (cont.)		114 – Grover Street		
			115 – Riverview Lift Station		
			117 – Missouri Avenue Lift Station		
Ohern/Monroe	(CSOs 118 and 119)	365	Construct CSO Deep Tunnel Drop Shaft Complex	The diversion of flows from CSOs 118 and 119 will be to storage tank facilities rather than to drop shaft / tunnel (see below), stored flow volume will then be pumped to the MRWWTP for treatment following wet-weather events	PROJECTS REMOVED: • Storage Tank at CSO 118 Storage Tank at CSO 119
			Construct industrial lift station and force main	Construct at MRWWTP 4.1 MG storage facility for CSO 118	
			Implement modifications to Monroe Street Lift Station	Construct at Industrial Lift Station site a 2.9-MG storage tank facility for CSO 119	Floatables control has been addressed through projects in the basin.
			Install floatables control at CSO 118 – South Omaha/Ohern Street and 119 – Monroe Street Lift Station outfalls	Sewer separation area reduced to 111 acres, because the 20th and U Sewer Separation project has been removed	
				Floatables control will be addressed with the construction of the CSO – 118 and 119 storage tanks	

TABLE 5-2
Technical Details of CSO Control Projects in the Missouri River Watershed

Facility	CSOs Impacted	2009 LTCP Description	Proposed Changes in 2014 LTCP Update	Proposed Changes in 2021 LTCP Update or Status
Missouri River Water Resource Recovery Facility (MRWRRF)				
MRWRRF Improvements				
	CSO 102	New headworks instantaneous peak capacity: 180 MGD Disinfection of CSO 102 – MRWRRF Primary Clarifier, instantaneous peak rate: 130 MGD New preliminary and primary treatment system for flow from SOIA	Schedules A and B1 under construction No changes proposed for Schedule B2	Project Complete
Industrial Force Main and Gravity Sewer (SOIA Force Main and Gravity Sewer)				
	CSO 102, 119	Force Main: 3,050 feet of 30 inches Gravity Pipe: 3,650 feet of 30 inches	Project complete	Project Complete
Industrial Lift Station (SOIA Lift Station)				
	CSO 102, 119	Rate: 18.3 MGD	Project complete	Project Complete
South Interceptor Force Main				
	CSO 102	Force main: 3,800 feet of 42 inches Force main: 19,500 feet of 66 inches	Project under construction	Project Complete
CSO Deep Tunnel				
	CSO 106, 107, 108, 109, and 115	Diameter: 17 feet Equalization volume: 48.2 MG Length: 5.4 miles Slope: 0.1 percent Maximum dewatering time: 24 hours Depth to invert: range of 160 to 180 feet	Diameter reduced to 15 feet Reduced the Equalization volume: 37.8 MG Added Drop Shaft Grit Removal facilities Number of drop shafts: 4	Project Removed from LTCP

TABLE 5-2
Technical Details of CSO Control Projects in the Missouri River Watershed

Facility	CSOs Impacted	2009 LTCP Description	Proposed Changes in 2014 LTCP Update	Proposed Changes in 2021 LTCP Update or Status
		Number of drop shafts: 5		
Tunnel Lift Station and Force Mains				
	CSO 106, 107, 108, 109, and 115	Rate: 52 MGD	Rate 22 MGD	Project Removed from LTCP
RTB at MRWRRF				
	CSO 106, 107, 108, 109, and 115	Maximum rate: 52 MGD Volume: 1.1 MG Number of basins: 3 Surface loading rate: 4,000 gallons/day/square foot Chlorine dosage: 15 mg/L Detention Time: 30 minutes	Maximum Rate: 22 MGD Volume: 0.5 MG	Project Removed from LTCP
RTB Dewatering Lift Station				
	CSO 106, 107, 108, 109, and 115	Rate: 1.1 MGD Maximum dewatering time: 24 hours	Rate changed: 0.5 MGD	Project Removed from LTCP
Bridge Street Basin				
Lift Station and Force Main				
	CSO 103	Rate: 8 MGD Automatic bar screens	No changes proposed	Project Removed from LTCP

TABLE 5-2
Technical Details of CSO Control Projects in the Missouri River Watershed

Facility	CSOs Impacted	2009 LTCP Description	Proposed Changes in 2014 LTCP Update	Proposed Changes in 2021 LTCP Update or Status
Sewer Separation to Deactivate CSO 103 – Bridge Street Lift Station				
	CSO 103	Area: 36 acres	No changes proposed	Project Complete
Minne Lusa Basin				
Sewer Separation to Reduce Combined Sewage Volume and Deactivate CSO 104 – Mormon Street				
	CSO 104	Separation, with monitoring and rehabilitation to take place prior to deactivation	No changes proposed	Outfall Deactivated, Project Complete
Stormwater Conveyance Sewer				
	CSO 105	Diameter: 12.5 feet Length: 1.5 miles Depth to invert: range of 45 to 75 feet Discharge to Storz Detention Basin; 1,800-foot-long trapezoidal channel	Diameter increased to 14 feet Added gate control structures at John Creighton Blvd, Paxton, Crown Point, and Miller Park to control flows to Storz/Pershing Detention Basin Storz/Pershing Basin to be permitted through NDNR as High Hazard Dam	Project Removed from LTCP
Phase 1 Storage Facility at CSO 105 – Minne Lusa Avenue				
	CSO 105	Tank storage volume: 1.0 MG Maximum dewatering time: 24 hours Dewatering rate: 1.0 MGD	Eliminated phased implementation. Resized to one storage tank at CSO 105 with a 4.0-MG capacity	Project Removed from LTCP
Phase 2 Storage Facility at CSO 105 – Minne Lusa Avenue				
	CSO 105	Tank storage volume: 2.7 MG Maximum dewatering time: 24 hours Dewatering rate: 2.7 MGD	Eliminated phased implementation. Resized to one storage tank at CSO 105 with a 4.0-MG capacity	Project Removed from LTCP

TABLE 5-2
Technical Details of CSO Control Projects in the Missouri River Watershed

Facility	CSOs Impacted	2009 LTCP Description	Proposed Changes in 2014 LTCP Update	Proposed Changes in 2021 LTCP Update or Status
Sewer Separation to Reduce Combined Sewage Volume				
	CSO 105	Area: 2,235 acres	Change in sewer separation concept in Paxton and JCB areas Sewer separation area reduced to 1,629 acres Eliminated: 41st & Sprague SE Phase 3, 41st & Sprague NW Phase 3, and 33rd & Taylor projects JCB & Miami Phase 1 and Phase 2 combined into single construction contract.	Sewer Separation in Paxton, JCB, and Lake James to Fontenelle projects are complete
CSO 105 Active Control Structure				
	CSO 105			Active control facility at the CSO 105 Outfall: • Two sluice gates to actively control overflows • Passive emergency overflow weirs for gate failure • Flap gates to protect against high river conditions.
Minne Lusa Relief Sewer Diversion Modifications				
	CSO 105, 106			Active control facilities: • DWF and wet weather flow to be directed to the MLRS • New gate structures • Junction boxes • Piping
Northeast Omaha RTB – 6th Street and Abbott Drive				

TABLE 5-2
Technical Details of CSO Control Projects in the Missouri River Watershed

Facility	CSOs Impacted	2009 LTCP Description	Proposed Changes in 2014 LTCP Update	Proposed Changes in 2021 LTCP Update or Status
	CSO 105, 106, 107, 108			Maximum treatment rate: 185 MGD Total volume:3.85 MG Lift station (185 MGD) Number of flushing bays: 7 Facility Dimensions: 146 ft W x 262 ft L x 28.5 ft D Surface loading rate: 6,000 gallons/day/square foot Chlorine dosage: 20 mg/L
Grace St and North Interceptor DWF Diversion Rehabilitation				
	CSO 106, 107			Rehabilitate and implement controls to actively operate the existing DWF sluice gates to maximize capture.
Burt-Izard Basin				
Sewer Separation to Reduce Combined Sewage Volume				
	CSO 108	Area: 472 acres	Sewer separation increased to 550 acres 23rd & Seward and 30th & Burdette sewer separation projects eliminated 26th & Corby Phases 1 – 5 removed from LTCP	Nicholas & Webster Phase 2 (no longer needed) and 18th and Seward (merged into Nicholas Phase 3 project) removed from the LTCP

TABLE 5-2
Technical Details of CSO Control Projects in the Missouri River Watershed

Facility	CSOs Impacted	2009 LTCP Description	Proposed Changes in 2014 LTCP Update	Proposed Changes in 2021 LTCP Update or Status
			Changed sewer separation concept to focus on southern portion of Basin	
North Downtown Conveyance Sewer – 11th and Izard to 6th and Abbott; 11th & Izard Grit and Screening Facility; and 11th and Izard Active Control				
	CSO 108			11th & Izard Active Control: • Divert flow from Sewer 1040 to the Northeast Omaha RTB • Convey flow via the North Downtown Conveyance Sewer • Two sluice gates • Passive emergency overflow weirs 11th & Izard Grit and Screening Facility: • Downstream of active control facility • Conveys flow to Northeast Omaha RTB North Downtown Conveyance Sewer: • 72-inch Diameter (Circular) • Capacity 100 MGD
21st and Cuming Active Control				
	CSO 108			• Divert flow toward 11th and Izard Active Control facility • Two sluice gates • Passive emergency overflow weirs

TABLE 5-2
Technical Details of CSO Control Projects in the Missouri River Watershed

Facility	CSOs Impacted	2009 LTCP Description	Proposed Changes in 2014 LTCP Update	Proposed Changes in 2021 LTCP Update or Status
Leavenworth Basin				
Lift Station				
	CSO 109	Rate: 43 MGD	Rate increased to 45 MGD; project complete	Project complete
Leavenworth Basin Storage Tank				
	CSO 109, 121			Storage Tank Volume 5.5 MG (138 ft W x 258 ft L x 51 ft D) Headworks Design Flow Rate: 185 MGD
				Number of flushing bays: 12
Jones Street to Leavenworth Diversion				
	CSO 121	Number of automatic sluice gates: 2 Size of sluice gates (height by width): 4 by 6 feet	No changes proposed	No changes proposed
South Interceptor Basin				
Sewer Separation to Reduce Combined Sewage Volume and Deactivate CSO 113 – Spring Street				
	CSO 113	Area: 33 acres	Project complete	Project complete
Sewer Separation to Reduce Combined Sewage Volume				
	CSO 110, 111, 112, 117	Area: 776 acres	Martha Street Phase 2, and Missouri Avenue Phase 3 eliminated (rehabilitation projects) CSOs 112 and 117 to be deactivated	The Hickory Street and Pierce Street sewer separation projects need to be re-evaluated, though funding is still included.

TABLE 5-2
Technical Details of CSO Control Projects in the Missouri River Watershed

Facility	CSOs Impacted	2009 LTCP Description	Proposed Changes in 2014 LTCP Update	Proposed Changes in 2021 LTCP Update or Status
Ohern/Monroe Basin				
Sewer Separation to Reduce Combined Sewage Volume				
	CSO 118, 119	Area: 365 acres	4.1-MG storage tank added for CSO 118 2.9-MG storage tank added for CSO 119 Deletion of 20th & U Sewer Separation Project Sewer separation area reduced to 111 acres Gilmore Phase 1 and Gilmore Phase 2 combined into single construction contract	Tanks at CSO 118 and 119 removed from LTCP Gilmore Phase 1 and 2 Project Complete

JCB = John A. Creighton Boulevard

mg/L = milligram(s) per liter

MLRS = Minne Lusa Relief Sewer

NDNR = Nebraska Department of Natural Resources

SOIA = South Omaha Industrial Area

TABLE 5-3
Summary of CSO Control Projects in the Papillion Creek Watershed

Basin	CSOs Impacted	2009 LTCP Sewer Separation Area (Acres)	2009 LTCP Projects	Changes in 2014 LTCP Update	Proposed Changes in 2021 LTCP Update
Cole Creek	CSOs 202, 203, and 204	860	Construct storage tank at CSO 204 – 63rd and Ames, 0.08 MG	Sewer separation reduced to 776 acres	PROJECTS REMOVED: • CSO 204 Storage Tank • CSO 204 Phase 2 (replaced by 61st & Radial Storm Sewer) • CSO 204 Phase 5
			Install floatables control at CSOs 202 – 72nd and Bedford, 203 – 69th and Evans, and 204 – 63rd and Ames outfalls	CSO 204 storage tank reduced to 0.05 MG due to model update and recalibration CSOs 202 & 203 are planned to be deactivated	PROJECTS ADDED: • 61st & Radial Storm Sewer • East Cole Creek Interceptor Rehabilitation
Papillion Creek North (PCN)	CSOs 210, 211, and 212	219	Deactivate CSOs 211 – 69th and Pierce, and 212 – 69th and Woolworth	Sewer separation increased to 238 acres based on mapping	PROJECTS REMOVED: • CSO 210 Inflow Reduction • CSO 211 Inflow Reduction
			Deactivate outfall or install floatables control at CSO 210 – 72nd and Mayberry outfall	CSO 210 is planned to be deactivated	
Saddle Creek	CSO 205	549	Construct RTB at 64th and Dupont for flow rate of 315 MGD	Sewer Separation Projects Complete (reduced to 305 acres based on refined Aksarben Service area)	PROJECTS CHANGED: • Saddle Creek RTB (SCRTB) resized to a flow rate of 160 MGD with the ability to screen, remove grit, and disinfect flows of up to 320 MGD; project is under construction
			Install floatables control at outfall	Floatables control will be addressed with the construction of the RTB	

TABLE 5-3
Summary of CSO Control Projects in the Papillion Creek Watershed

Basin	CSOs Impacted	2009 LTCP Sewer Separation Area (Acres)	2009 LTCP Projects	Changes in 2014 LTCP Update	Proposed Changes in 2021 LTCP Update
Papillion Creek South	CSOs 206, 207, 208, and 209	186	Deactivate CSOs 207 – 44th and Y Street, 208 – 45th and T Street, and 209 – 44th and Harrison	No changes proposed	No changes proposed

TABLE 5-4
Technical Details of CSO Control Projects in the Papillion Creek Watershed

Facility	CSOs Impacted	Description	Changes in 2014 LTCP Update	Proposed Changes in 2021 LTCP Update
Cole Creek Basin				
Storage Tank at CSO 204 – 63rd and Ames				
	CSO 204	Total storage volume: 0.08 MG	Total storage volume changed to 0.05 MG	Project removed from LTCP
		Maximum dewatering time: 72 hours		
		Dewatering rate: 0.03 MGD		
Sewer Separation to Reduce Combined Sewage Volume				
	CSO 202, 203, 204	Area: 860 acres	Reconfigured phases to eliminate phases 7 - 9 and reduced amount of sewer separation area to 776 acres	Removed CSO 204 Phases 2 and 5 CSO 204 Phase 1 complete
61st & Radial Storm Sewer				
	CSO 204			Diameter: 42-48-inches
				Length: 1,300 to 2,300 LF (depends on alternative; budget based on maximum)
				Depth to invert: 10-30 feet
East Cole Creek Interceptor Rehabilitation				
	CSO 202, 203			Diameter: CIPP lining of 18 and 24-inch VCP
				Length: 11,000 LF
Papillion Creek North Basin				
Sewer Separation to Reduce Combined Sewage Volume and Deactivate CSOs 211 – 69th and Pierce, 212 – 69th and Woolworth, and, if possible, 210 – 72nd and Mayberry				
	CSO 210, 211, 212	Area: 219 acres	Increased sewer separation area to 238 acres	Deleted CSO 210 and CSO 211 Inflow Reduction Projects
			Changed scope of the CSO 210 and 211 projects from interceptor construction to inflow reduction	

TABLE 5-4
Technical Details of CSO Control Projects in the Papillion Creek Watershed

Facility	CSOs Impacted	Description	Changes in 2014 LTCP Update	Proposed Changes in 2021 LTCP Update
Saddle Creek Basin				
SCRTB				
		Maximum treatment rate: 315 MGD	Chlorine Dosage: 20 mg/L	Reduced flow to 160 MGD with grit, screening, and disinfection for a max of 320 MGD
		Total volume: 6.6 MG	Dimensions, each basin (width by length by depth): 80 by 225 by 16.7 feet	Total volume changed to 3.3 MGD
		Number of basins: 3		Dimensions, each basin (length by width): 205 feet by 120 feet
		Dimensions, each basin (length by width by depth): 264 by 66 by 16.7 feet		Number of Basins: 1
		Surface loading rate: 6,000 gallons/day/ square foot		Surface Loading Rate: 6,000 gallons/day/square foot
		Chlorine dosage: 15 mg/L		Chlorine Dosage: 20 mg/L (design capacity of 50 mg/L)
		Detention time: 30 minutes		Detention Time: 30 minutes (160 MGD)
RTB Dewatering Lift Station				
		Dewatering rate: 6.6 MGD	No changes proposed	Dewatering rate: 4.8 MGD Maximum dewatering time: 21 hours
		Maximum dewatering time: 24 hours		
Sewer Separation to Reduce Combined Sewage Volume				
		Area: 549 acres	Reduced to 305 acres	Projects complete
Papillion Creek South Basin				
Sewer Separation to Reduce Combined Sewage Volume and Deactivate CSOs 207 – 44th and Y Street, 208 – 45th and T Street, and 209 – 44th and Harrison				
		Area: 186 acres	No changes proposed	CSOs 207 and 209 deactivated

CIPP = cured-in-place pipe
LF = linear foot (feet)
VCP = vitrified clay pipe

5.3.1 Inflow and Infiltration Reduction Program

The LTCP includes some sewer separation projects that are intended to allow for the deactivation of CSO outfalls. However, it is possible that after sewer separation is completed, remaining inflow sources may prevent the closure, deactivation, and removal as a permitted CSO outfall. Therefore, it is necessary to implement a program that addresses these remaining wet weather impacts to support the goals of the CSO Program. These remaining flows are from inflow sources including private connected downspouts and area drains, private service lateral defects, and aged public systems with open joints, fractures, or missing mortar in pipes and manholes. In previous LTCPs, the City identified specific projects for inflow reduction; however, it was uncertain if the projects as envisioned would ultimately be needed or be appropriate. This update proposes to develop a program targeted at inflow and infiltration (I/I) reduction.

After case studies involving post-construction monitoring in basins draining to CSOs 103, 104, 208, 209, 211, and small portions of CSO 204, the City has found that I/I reduction projects require a strategic plan. In the case of CSOs 104 and 209, very minor repairs were needed to ensure confidence in closure of the CSO diversions. In other basins, a more intensive rehabilitation and higher-cost solution would be needed. With the City undergoing a thorough Capacity Management, Operations, and Maintenance (CMOM) gap analysis in 2017 to 2018 and setting a goal to develop risk-based asset management programs, a more systematic approach is being developed than through specific projects in the LTCP. The CSO Program is dedicating funding for inflow sources that will be addressed on an as-needed basis to achieve the ultimate goals of the CSO Program. The City will also be developing I/I reduction programs that support sewer system reliability and growth, in parallel and in collaboration with the CSO Program.

Identification of inflow sources is accomplished through the evaluation of flow monitoring and other data such as from closed-circuit television, manhole inspections, and smoke testing. Addressing the sources of inflow can range from small projects that the City can implement with in-house resources, such as blocking off a cross-connection or sealing a manhole, to large ones that require engineering and construction contractor procurement. These projects are not meant to provide additional volume capture necessarily but are potentially necessary to achieve deactivation of the CSO outfalls. The target would be to ensure that the system has a normal rate of I/I for a separate sanitary system An efficient means of addressing these remaining inflow sources is to implement a process to identify and address significant sources of inflow within each CSO basin when and if needed, with focus on smaller sewersheds to isolate the issues.

The City aims to establish an I/I Reduction Program that will address further wet weather impacts after completion of sewer separation. This will be focused primarily within the PCW and potentially could include inflow reduction in the CSO basins upstream of CSO 202, CSO 203, CSO 204, CSO 208, CSO 210, CSO 211, and CSO 212. It is not anticipated that inflow reduction will be necessary in all CSO basins where sewer separation has been completed and may not be needed in any of them. The goal of the program will be to achieve the anticipated CSO deactivation committed to in the 2021 LTCP Update.

During the first 2 years of implementing the 2021 LTCP Update, the City will refine procedures for the uniform collection and analysis of data, prioritization of projects, and implementation of corrective actions to address the significant sources of inflow. The proposed process to be implemented involves the following steps. It should be noted that this process may be modified during this 2-year period.

1. Analysis of existing information. The first step of the evaluation will be to look at the information that is currently available in the basin; this could include a review of previously collected field data, existing flow data, system complaints, and other information available.

2. Identification and quantification of inflow sources. This involves the evaluation of the sewer system in a CSO basin using various methods, including but not limited to, hydraulic modeling, flow monitoring within the basin, performing condition assessments of the sewer system, field investigations such as smoke or dye testing, and closed-circuit television. Where inflow sources are not identified within the CSO project area, the evaluation will consider upstream areas within the CSO basin.

3. Development of a prioritized list of inflow sources. Based on data gathered on the sources of inflow for each basin, the City will develop a prioritized list of inflow sources, based on the significance of the inflow and the cost and impact of addressing the source of inflow.

4. Implementation of remedy. The City will develop an approach for remediating the inflow sources and a plan for implementation. The plan will be implemented based on the availability of City resources and subject to revision.

5. Confirmation of remediation. Upon completion of the implementation of the remedy, the system will be monitored to determine the amount of inflow reduced and if additional remediation is needed.

The results of the evaluation and the implementation of the remedies will be summarized in each year's Annual Report to Nebraska Department of Environment and Energy (NDEE). The City will report on the progress of the I/I Reduction Program by reporting on the status of any analysis, projects completed, and inflow sources addressed, as well as modifications, if any, to the program.

5.3.2 Green Infrastructure Program

The City will continue to implement and define their Green Infrastructure Program. Green infrastructure will still not be a fundamental element of the City's approach to achieve 85 percent capture; however, it can provide some amount of additional wet weather volume capture, water quality benefits, and improve local stormwater management issues. The City's Green Infrastructure Program includes projects and initiatives such as the following:

- **Maximizing the use of existing green infrastructure through real-time controls (RTCs)**. In addition to providing better operations in general, one of the elements of this task is to evaluate the use of RTCs to maximize the use of the various existing green infrastructure assets to cost effectively improve volume capture and collection system operability. Potential enhancements to existing stormwater facilities will be evaluated, with the goal of maximizing the use of the stormwater facilities and the storage/conveyance capacity in the CSS to improve CSO control. It is anticipated that the evaluations will include the use of RTCs to provide active management of the facilities as well as the potential rainfall monitoring to predict or proactively drawdown pond levels ahead of storm events to facilitate detaining a larger volume of runoff. The potential benefit to CSO control in the representative year will be determined, and locations where system status information such as depth of flow is needed to make control decisions will be identified. It is anticipated that the evaluations will consider potential enhancements to the following stormwater facilities:

- Fontenelle Park Lagoon – will build on preliminary work for preemptive drawdown of pond to detain a larger volume of stormwater, determine appropriate preemptive dewatering flow rate into CSS without causing adverse downstream impacts, and identify where and how level, rainfall, and/or flow data need to be acquired
- Adams Park – consider whether enhancements to outlet controls would be feasible and beneficial to CSO reduction
- 20th/Poppleton underground stormwater infiltration gallery – evaluate whether it is feasible to reconfigure or enhance existing controls to detain/infiltrate smaller storm events than current operation allows, without adversely affecting infiltration gallery with grit and trash
- Vinton underground stormwater infiltration gallery – evaluate what system information is needed to control the future valve to increase detention and infiltration
- Hanscom Park Lagoon – build on preliminary work for preemptive drawdown of lagoon to detain a larger volume of stormwater, determine appropriate preemptive dewatering flow rate into CSS without causing adverse downstream impacts, and identify where and how level, rainfall, and/or flow data need to be acquired

- **Development/Private Opportunities**. The City will continue to look for partnering, incentive, and funding opportunities, and implementing different design requirements to reduce CSOs when development opportunities arise. To prioritize CSS areas that could have the largest impact on the CSO Program, an evaluation was performed to determine what CSO areas would have the best potential for green infrastructure or inflow reduction based on overflow reduction effectiveness (ORE). OREs predict how much CSO will be reduced with a given reduction in runoff. As such, they can be used to prioritize green infrastructure projects. Figures were created that can be used as a planning tool to understand where green infrastructure would be most beneficial to CSO control. If the City chooses to develop an incentive program to promote implementation of green infrastructure, the figures could be used as a basis in developing a funding strategy or mechanism for private landowners to develop green infrastructure beyond or above the current requirements. Figure 5-2 is an example ORE map, which shows the overflow reduction effectiveness assuming 10 percent of the existing impervious area is controlled via green infrastructure. Higher numbers (and greener colors) indicate areas with higher efficiencies, meaning that more of the inflow reduction translates directly to CSO volume reduction, or thought of another way: less inflow reduction will be required than in areas with lower efficiency numbers, to achieve a comparable level of CSO volume reduction. Further information about the ORE analysis can be found in Appendix E.
- **Incentive Program**. It is currently the City's plan to evaluate the possibility of developing an incentive program for implementation of green infrastructure on private property. Other CSO communities such as Onondaga County, New York, have used similar programs effectively to improve stormwater management.

- **City Programs**. City programs or initiatives will be explored that could promote or require implementation of green infrastructure as part of City projects and operation. As part of the development of this program, the City would focus on interdepartmental coordination, communication, and strategy. Tasks could include investigating opportunities internal to City, meeting with other City stakeholders to determine appetite for implementation, potential for ordinance modifications, maintenance requirements, and funding strategies. Other communities have found that implementation of green infrastructure as part of a larger project is more cost effective than construction of standalone projects.

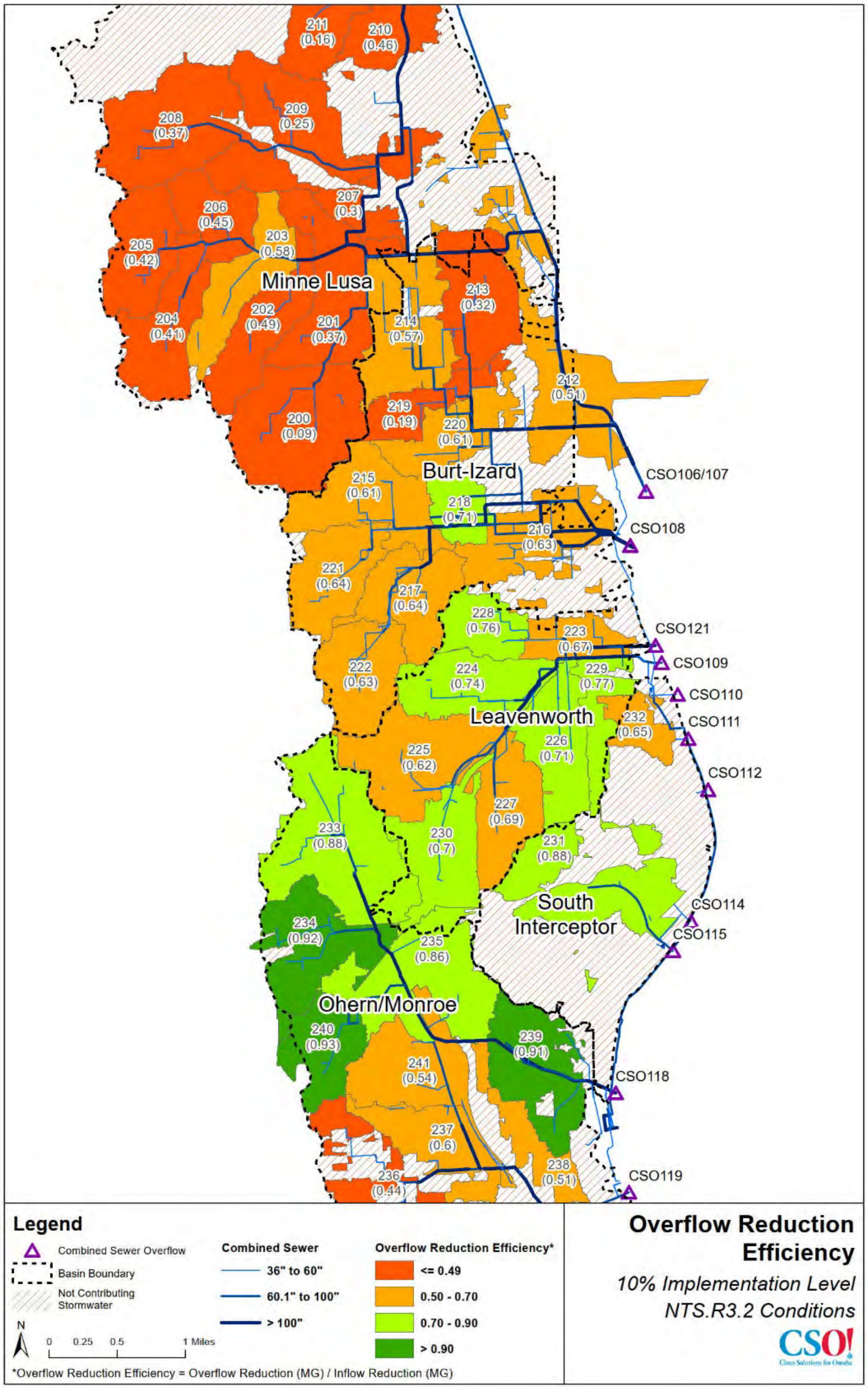

FIGURE 5-2
Overflow Reduction Efficiency Map

The City will continue to develop its Green Infrastructure Program as noted in the 2009 LTCP and 2014 LTCP Update. This will continue to include requiring project teams to evaluate the potential for incorporation of green infrastructure in all CSO projects and working with the City to implement the processes that facilitate the inclusion of green infrastructure.

5.4 Program CSO Controls and Costs

Table 5-5 summarizes the capital costs of the 2021 LTCP Update categorized according to significant project categories. The costs have been escalated to the years of scheduled implementation. The total escalated estimated cost of the LTCP is now $1,998,952,000, or approximately $2 billion.

TABLE 5-5
Summary of CSO LTCP Costs

Project(s)	2021 LTCP Update Cost
High Rate Treatment Projects	$422,811,000
SIFM Project	$87,429,000
MRWRRF Improvements	$183,664,000
Lift Station Projects	$158,130,000
Storage Structure Projects	$185,203,000
Sewer Separation Projects	$532,298,000
Active Controls	$85,343,000
LTCP Ongoing Costs	$320,659,000
Miscellaneous Project Costs	$23,415,000
Total	$1,998,952,000

When the total capital costs for the 2009 LTCP, 2014 LTCP Update, and 2021 LTCP Update are expressed at the same cost basis, they show that the total estimated cost in the 2021 LTCP Update has been reduced from those in the 2009 LTCP and 2014 LTCP Update. The primary reasons for this cost difference are a focus on the 85 percent capture requirement and ongoing efforts to re-evaluate and adapt the LTCP.

5.5 Modeling of Updated Proposed CSO Controls

The CSO controls were modeled to ensure that they will achieve the 85 percent wet weather volume capture requirement. The controls listed in previous sections were modeled as described with two exceptions. The SCRTB, while designed to benefit water quality by disinfecting more than the 160-MGD design capacity, was modeled at the design capacity. Also, the 61st and Radial Storm Sewer project (in the CSO 204 area) was modeled using a range of results, as it is still under conceptual development.

5.5.1 Combined Sewer System Modeling Results

Table 5-6 shows the CSO volumes and frequencies for 2002 Existing Conditions and LTCP Conditions. Figures 5-3 and 5-4 provide a graphical representation of the CSO volumes in the Missouri River and Papillion Creek Watersheds, respectively. The figures primarily illustrate the CSO volumes, but the volumes treated by the two RTBs and the MRWRRF Chlorine Contact Basin are also shown.

TABLE 5-6
CSO Volumes and Frequencies for Existing and LTCP Conditions

CSO	Location	Exist. Cond. (2002) CSO Volume (MG)	Exist. Cond. (2002) CSO Frequency	LTCP Update (2037) CSO Volume (MG)	LTCP Update (2037) CSO Frequency
102	MRWRRF	283.7	81	treated	treated
103	Bridge Street Lift Station[a]	0.3	6	0.0	0
104	Mormon Street	4.4	13	closed	closed
105	Minne Lusa Avenue	472.0	86	43.7	4
106	North Interceptor	431.0	67	76.6[b]	9[b]
107	Grace Street	214.0	64		
108	Burt-Izard Street	407.1	43	84.5	15
109	1st and Leavenworth	490.7	54	144.5	14
110	Pierce Street Lift Station	5.6	28	5.4	25
111	Hickory Street Lift Station	0.1	3	<0.1	3
112	Martha Street[a]	6.1	20	0.0	0
113	Spring Street Lift Station	0.1	3	closed	closed
114	Grover Street	7.8	38	3.2	9
115	Riverview Lift Station	47.4	37	30.3	25
116	Homer Street	2.7	22	closed	closed
117	Missouri Ave Lift Station	30.3	37	closed	closed
118	South Omaha – Ohern Street	197.9	35	179.2	33
119	Monroe Street Lift Station	238.2	86	67.7	16
121	Jones Street	38.3	14	18.9	3
	Missouri River Watershed	**2877.8**		**654.2**	
201	PCWRRF	28.1	8	0.0	0
202	72nd and Bedford	15.3	41	closed	closed
203	69th and Evans[a]	3.9	27	0.0	0
204	63rd and Ames	68.7	64	1.4 - 12.0[c]	3 - 31[c]
205	64th and Dupont	652.9	64	202.6	6
206	43rd and S Street	0.0	0	closed	closed
207	44th and Y Street	4.9	18	closed	closed
208	45th and T Street[a]	0.1	3	0.0	0
209	44th and Harrison	0.0	0	closed	closed

TABLE 5-6
CSO Volumes and Frequencies for Existing and LTCP Conditions

CSO	Location	Exist. Cond. (2002) CSO Volume (MG)	Exist. Cond. (2002) CSO Frequency	LTCP Update (2037) CSO Volume (MG)	LTCP Update (2037) CSO Frequency
210	72nd and Mayberry[a]	3.3	15	0.0	0
211	69th and Pierce[a]	0.1	16	0.0	0
212	69th and Woolworth[a]	0.0	0	0.0	0
	Papillion Creek Watershed	**777.4**		**204.0 – 214.6**	

[a] It is the City's goal to close these outfalls after monitoring indicates they can be closed without adverse consequences.

[b] Flows from the diversions for CSOs 106 and 107 will be consolidated and sent to the Northeast Omaha RTB diversion, where the flows will either enter the RTB or be diverted as CSO. Therefore, the CSO volume and frequency are reported for both outfalls together.

[c] Projects to control flow associated with the CSO 204 Pratt diversion are still being evaluated. It is anticipated that final results will be in the ranges given for CSO volume and frequency.

PCWRRF = Papillion Creek Water Resource Recovery Facility

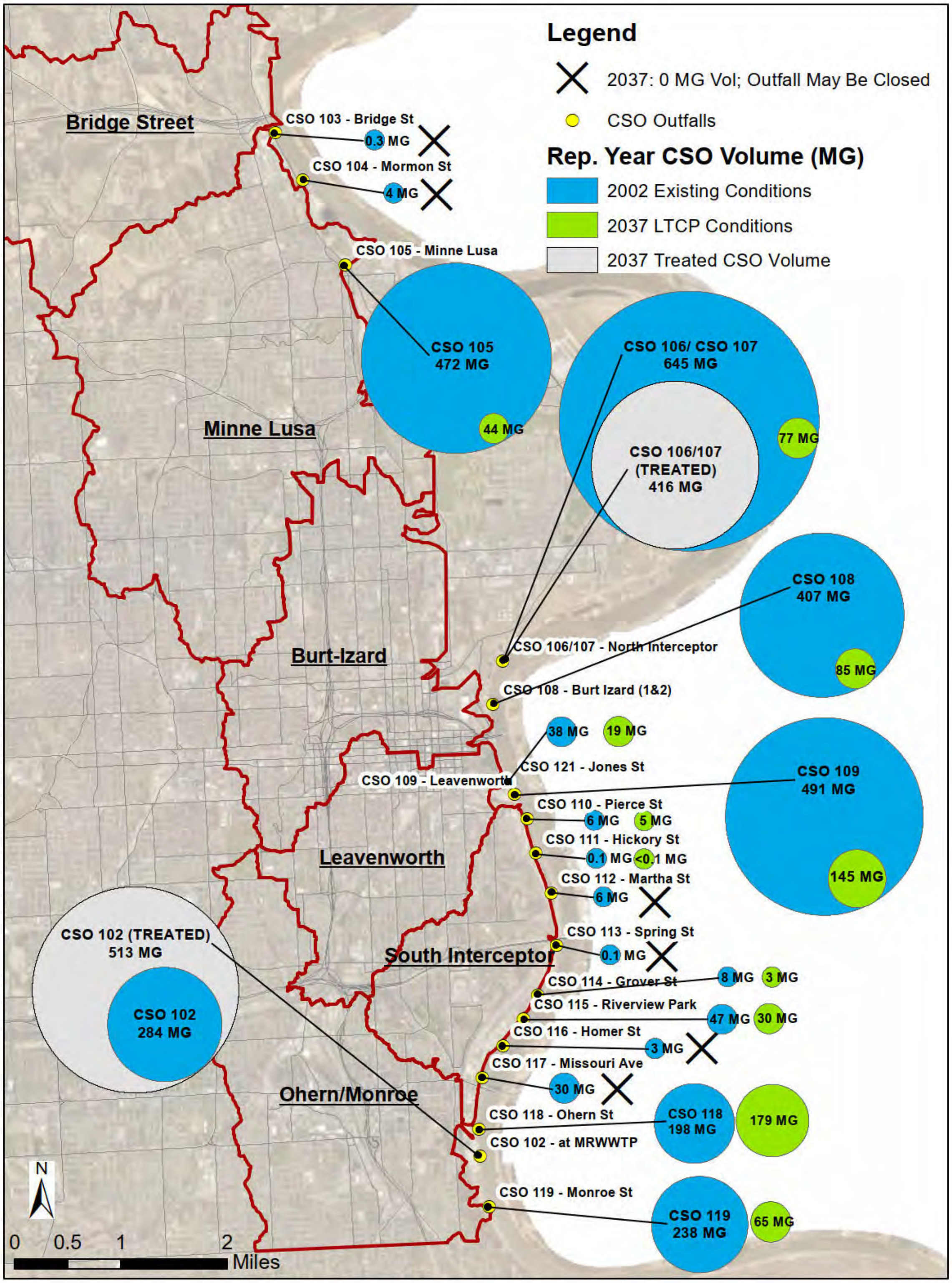

FIGURE 5-3
Graphical Representation of CSO Overflow Volumes in 2002 Compared to 2037 for the Missouri River Watershed

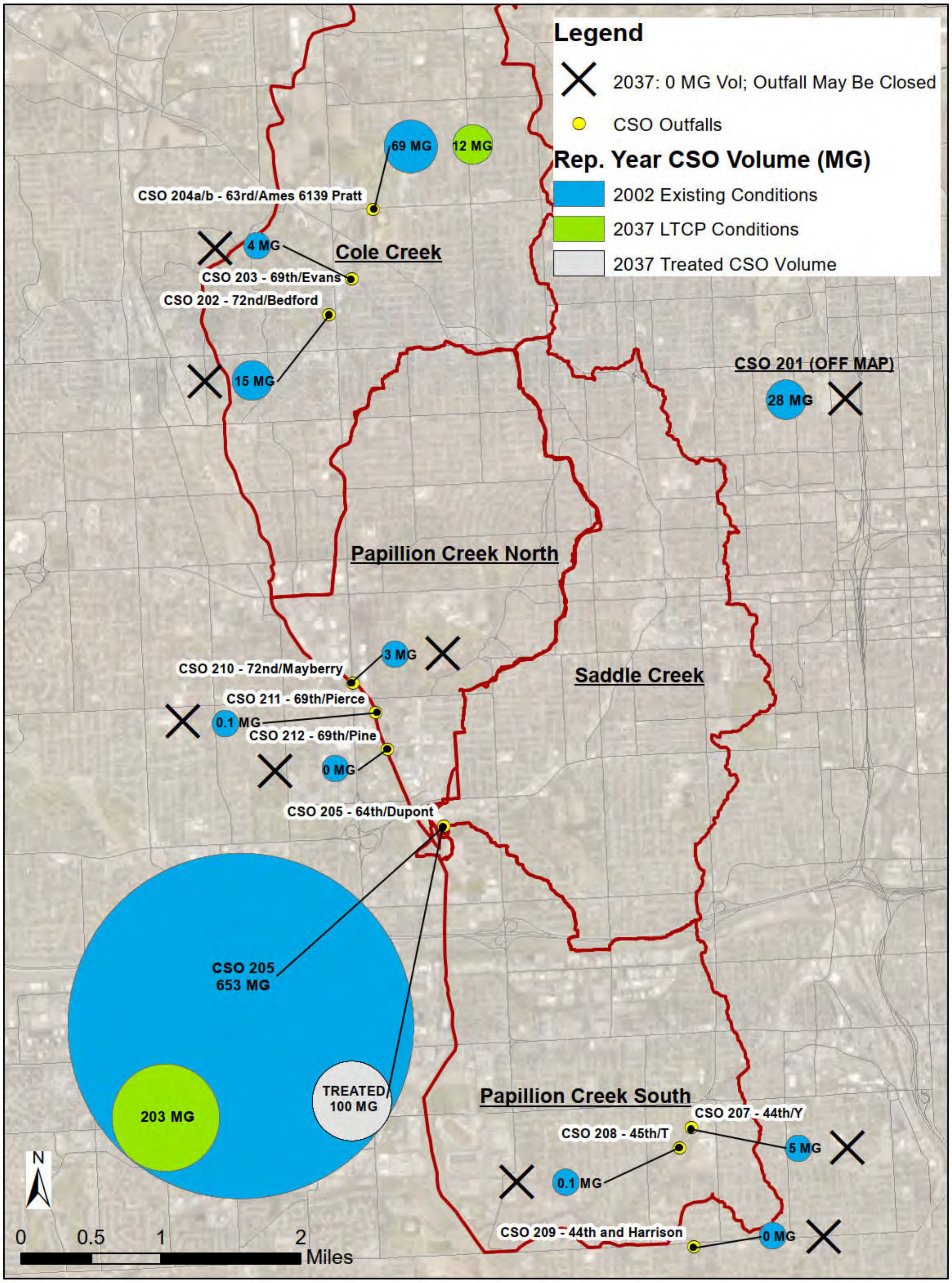

FIGURE 5-4
Graphical Representation of CSO Overflow Volumes in 2002 Compared to 2037 in the Papillion Creek Watershed

In the MRW, 85 percent of the wet weather combined sewer flows is predicted to be eliminated or captured for treatment during representative year precipitation. Figure 5-5 provides a comparison of CSO volumes between Existing and LTCP Update Conditions for representative year precipitation. Because the CSS in the MRW is in an area that is already developed, the volumes under Existing Conditions (2002) and LTCP Conditions are directly comparable. The wet weather volumes—which are volumes of flow captured by the various controls and the CSO volume—are shown in Table 5-7.

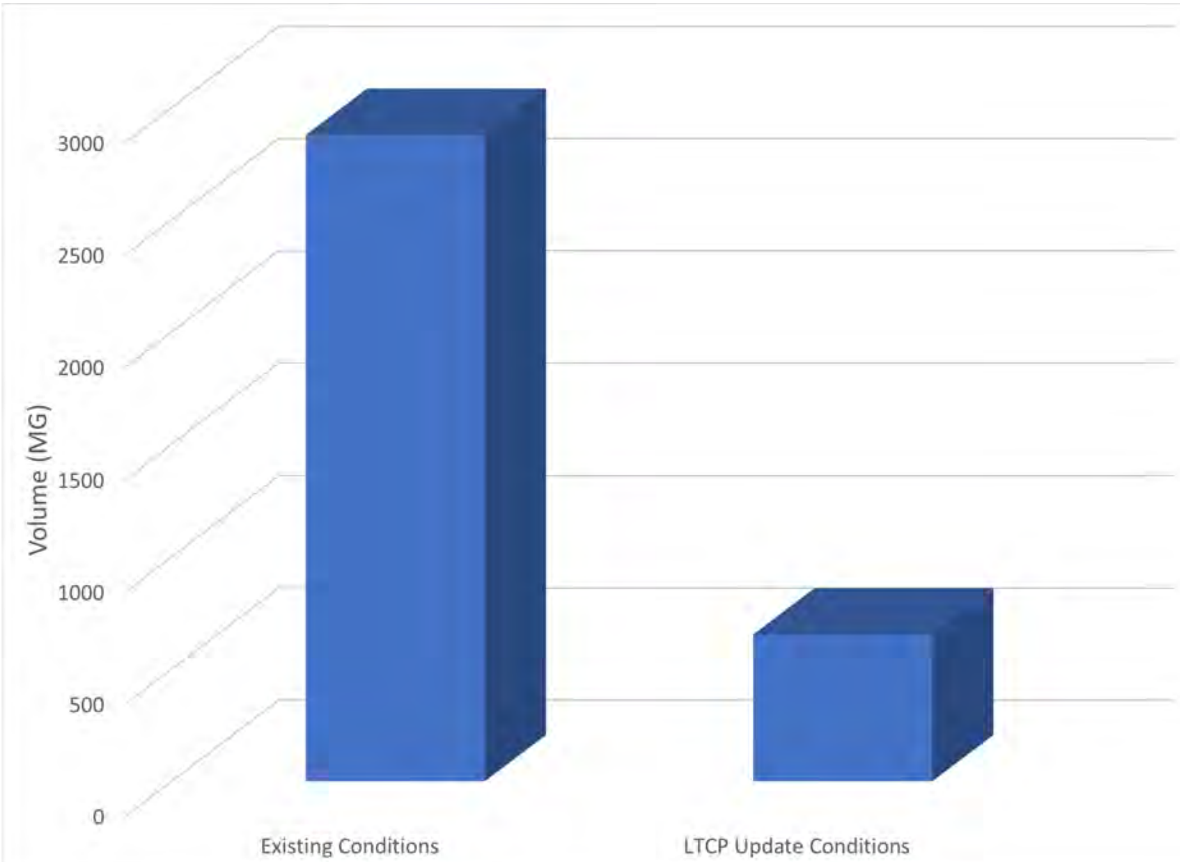

FIGURE 5-5
CSO Volume Comparison for Missouri River Watershed in the Representative Year

TABLE 5-7
Wet Weather Volume Captured in the Missouri River Watershed in the Representative Year

Control	LTCP Update Volume Captured (MG)	LTCP Update Volume Not Captured (MG)
MRWRRF Secondary Treatment (includes flow dewatered from the Northeast Omaha RTB and Leavenworth Basin Storage Tank)	2,080	—
CSO 102 – MRWRRF Primary Clarifier Primary Treatment and Disinfection	512	—
Grace RTB Treatment	416	—
Stormwater Separated Out of CSS	600	—
CSO	—	654
Unaccounted Volume[a]	—	<1
TOTAL	**3,609**	**654**
PERCENT CAPTURE	**85%**	—

[a] Unaccounted volume is the balance of volume needed to make the total volume available in the CSS under LTCP conditions match that under Existing Conditions. To be conservative, it is presumed to not be captured.

Figure 5-6 shows a comparison of 2002 and LTCP wet weather volumes in MRW. The increase in secondary treatment volume, the elimination of stormwater volume, and the addition of treated volume through the Northeast Omaha RTB and use of the Chlorine Contact Basin for CSO 102 can be clearly seen on the figure, resulting in a significant decrease in the CSO volume.

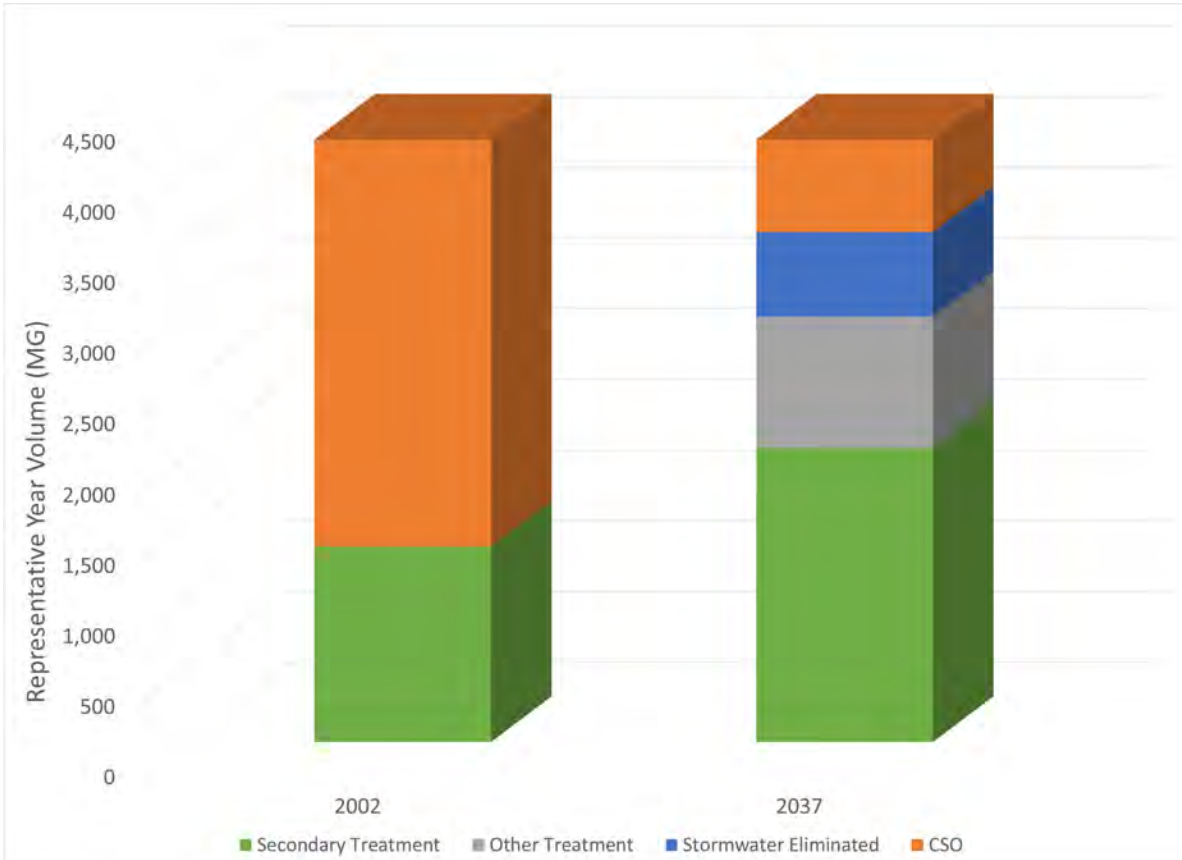

FIGURE 5-6
2002 and 2037 Wet Weather Volumes for Missouri River Watershed in the Representative Year

In the PCW, 97 percent of the wet weather combined sewer flows are predicted to be captured per the 2021 LTCP Update Conditions. The volumes of flow captured by the various controls and the CSO volumes are shown in Table 5-8 and Figure 5-7. In the PCW, development (and thus increased sanitary flow) is expected to occur before the LTCP is fully implemented, and thus the total volumes under Existing Conditions and LTCP Conditions are not the same.

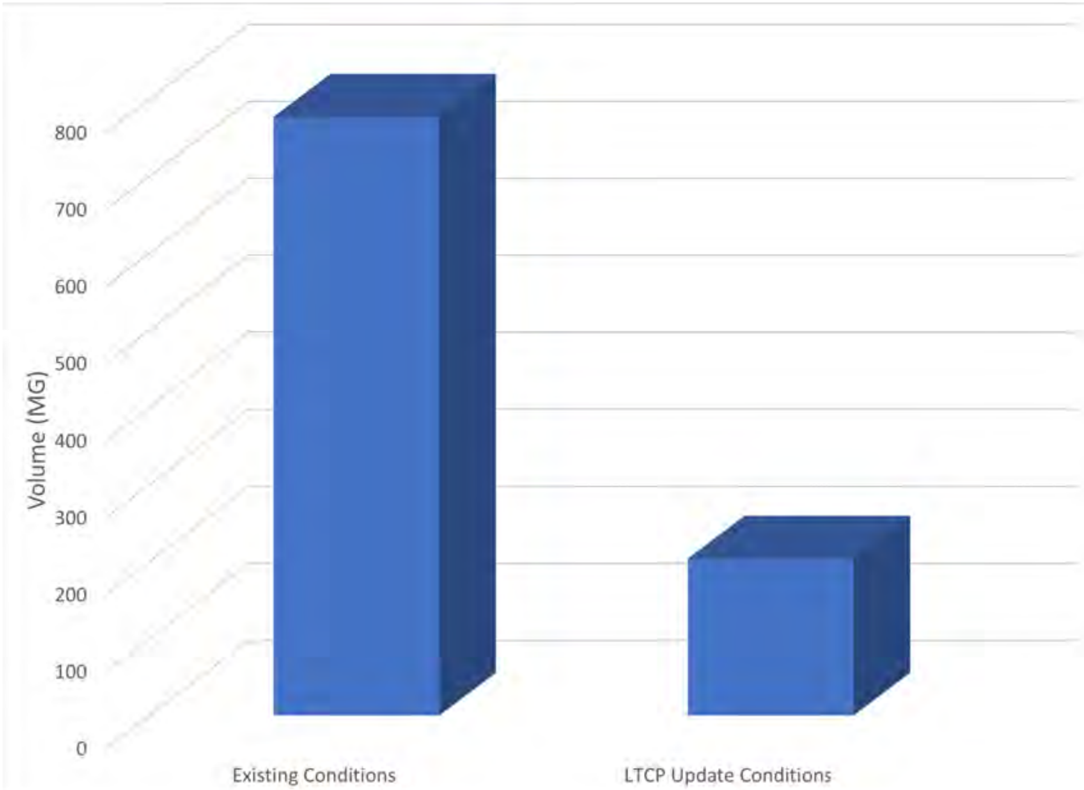

FIGURE 5-7
CSO Volume Comparison for Papillion Creek Watershed in the Representative Year

TABLE 5-8
Wet Weather Volume Captured in the Papillion Creek Watershed in the Representative Year

Control	LTCP Update Volume Captured (MG)	LTCP Update Volume Not Captured (MG)
PCWRRF Secondary Treatment (includes flow dewatered from the Saddle Creek RTB)	5,611	—
Saddle Creek RTB Treatment	100	—
Stormwater Separated Out of CSS	285	—
CSO	—	204
Unaccounted Volume[a]	—	12
TOTAL	**5,996**	**216**
PERCENT CAPTURE	**97%**	—

[a] Unaccounted volume is the balance of volume needed to make the total volume available in the CSS under LTCP conditions match that under Existing Conditions. To be conservative, it is presumed to not be captured.

Figure 5-8 shows a comparison of 2002 and LTCP wet weather volumes in PCW. The secondary treatment volume increases due to development as well as increased treatment capacity. The 2002 CSO volume was a much smaller portion of the overall 2002 wet weather volume in PCW compared to MRW, but a significant reduction in CSO volume by eliminating stormwater and increasing both secondary treatment and RTB treatment for 2037 is evident on the figure.

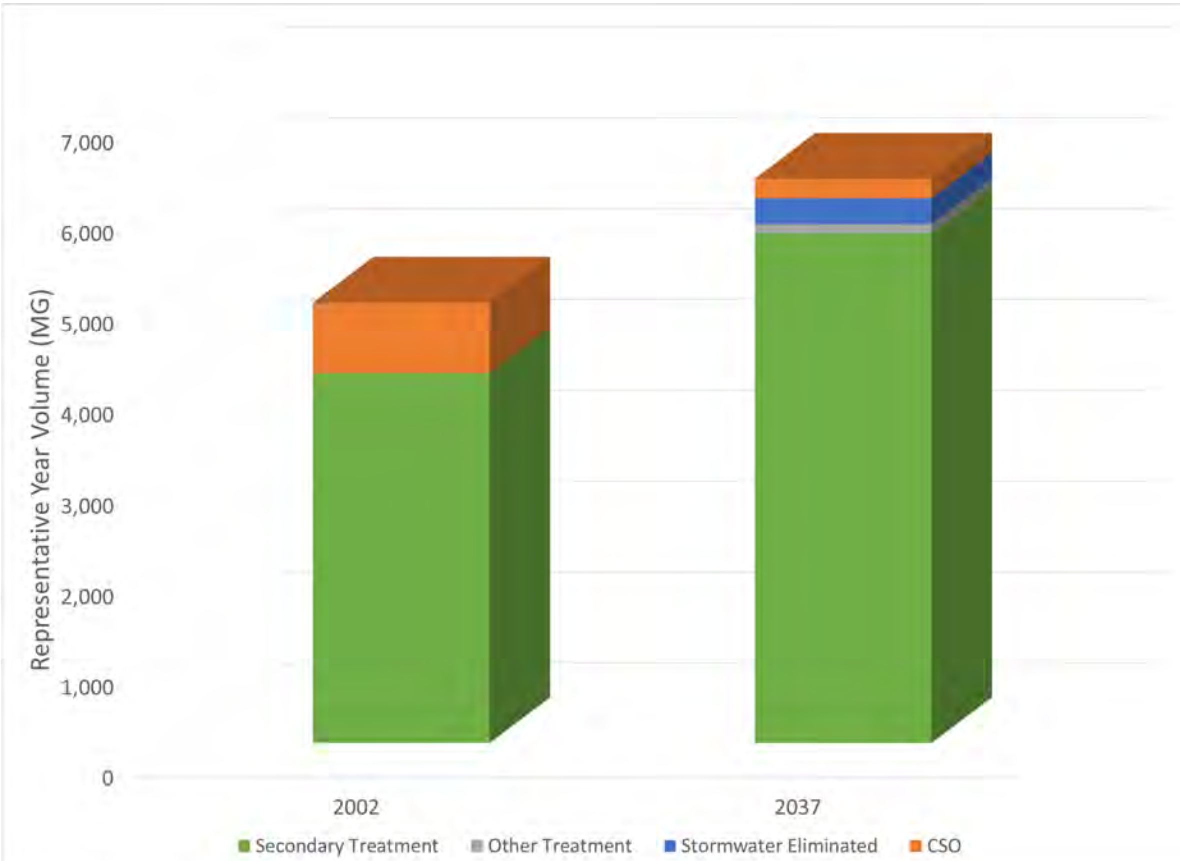

FIGURE 5-8
2002 and 2037 Wet Weather Volumes for Papillion Creek Watershed in the Representative Year

5.5.2 Water Quality Evaluation

An important element of the development of the 2021 LTCP Update was to evaluate the impact of the proposed controls on the receiving water quality of the Missouri River, Papillion Creek, and tributaries. The purpose of the water quality evaluation was to provide confidence regarding the presumption of meeting the water quality standard or not precluding the standard from being achieved. The primary focus of this evaluation is *E. coli*, as this is the pollutant of concern for CSOs identified by NDEE.

The water quality standard of 126 coliform units per 100 milliliters (cfu/100 mL) for *E. coli* applies to all streams with a primary Recreational Use classification, as established by NDEE. The standard only applies during the recreation season, which is May 1 to September 30. Based on NDEE guidance, compliance with the standard is judged by taking the geometric mean of all data, during the recreation season, in a segment, including both wet and dry weather results. To determine whether the proposed LTCP controls will achieve this value, the new Missouri River Water Quality Model was used for the river and the updated spreadsheet model for Papillion Creek tributaries.

To evaluate the water quality impacts, the 2004 recreation season (May 1 through September 30) Missouri River flows were used. The 2004 recreation season was chosen because it was a "low flow year" in the Missouri River at Omaha (USGS 06610000) based on an analysis of recreation season flows from 1984 through 2019, excluding years with flooding. The 2004 recreation season median flow of 32,500 cubic feet per second (cfs) is equal to the 31st percentile flow of the whole dataset. Since the modeling was of a whole recreation season, it is considered more realistic to select the varying river flow than selecting a single 7Q10 condition. Both models calculated *E. coli* values, daily for the Papillion Creek Model and shorter time steps for the Missouri River, that were then geometrically averaged over the recreation season to calculate the overall *E. coli* geometric mean for the recreation season.

Figure 5-9 shows a hydrograph of Missouri River modeled flows at monitoring location MR5, which is at NP Dodge Park, just upstream of Omaha.

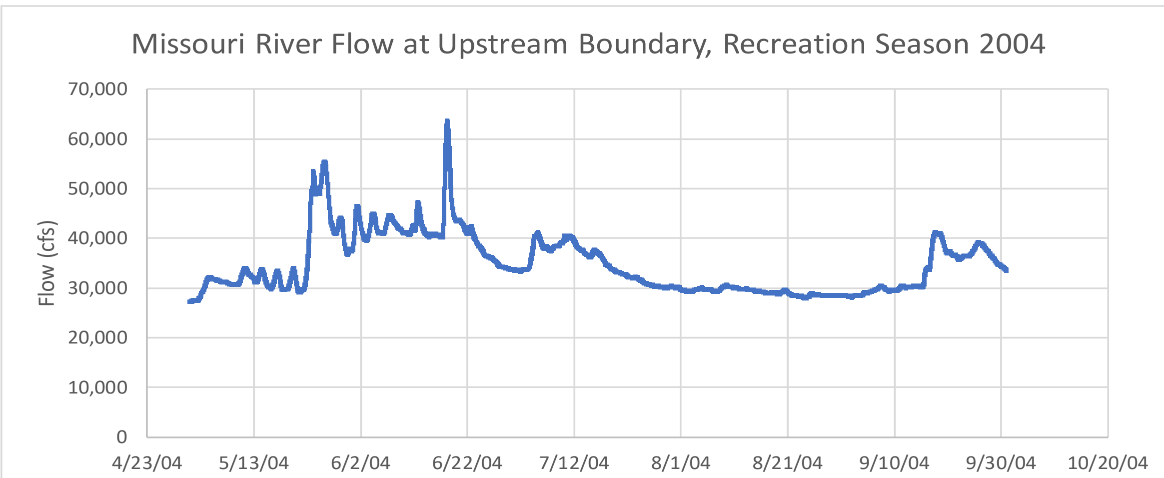

FIGURE 5-9
Modeled Missouri River Base Flow at the Upstream Boundary for the 2004 Recreation Season

For Papillion Creek, the City used the spreadsheet model developed for the 2009 LTCP and updated for the 2014 LTCP Update. It was revised to make it consistent with assumed values developed for the Missouri River model. For Papillion Creek flows, USGS StreamStats was not available for Papillion Creek nor were gaged data available in 2004 at Fort Crook station (USGS 06610795). A flow duration curve analysis was performed on Fort Crook data, and on the difference between Missouri River at Decatur and Omaha gaged data (i.e., 'differenced flow') to characterize localized wet weather events. Appendix C provides a detailed summary on how the flows were developed. Figure 5-10 provides the modeled flows of Papillion Creek just above its confluence with the Missouri River. These were the base flows used in the model.

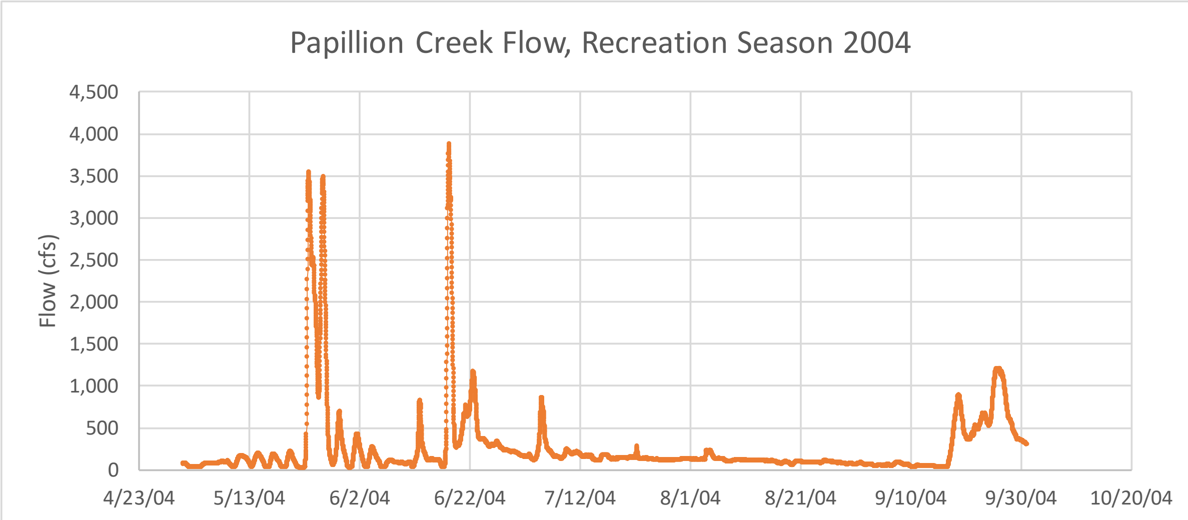

FIGURE 5-10
Modeled Papillion Creek Base Flow for the 2004 Recreation Season Upstream of the Confluence with the Missouri River

The model development is summarized in Section 2 and in Appendix C. Figure 5-11 shows the reaches of the Missouri River modeled, which stretch from NP Dodge Park to just below the confluence of Papillion Creek and the Missouri River, with the various locations where *E. coli* geometric means were calculated circled in red. The location noted as (cross section) 615.15 is just below CSO 109, so it is just below the river reach that includes the largest CSOs by volume.

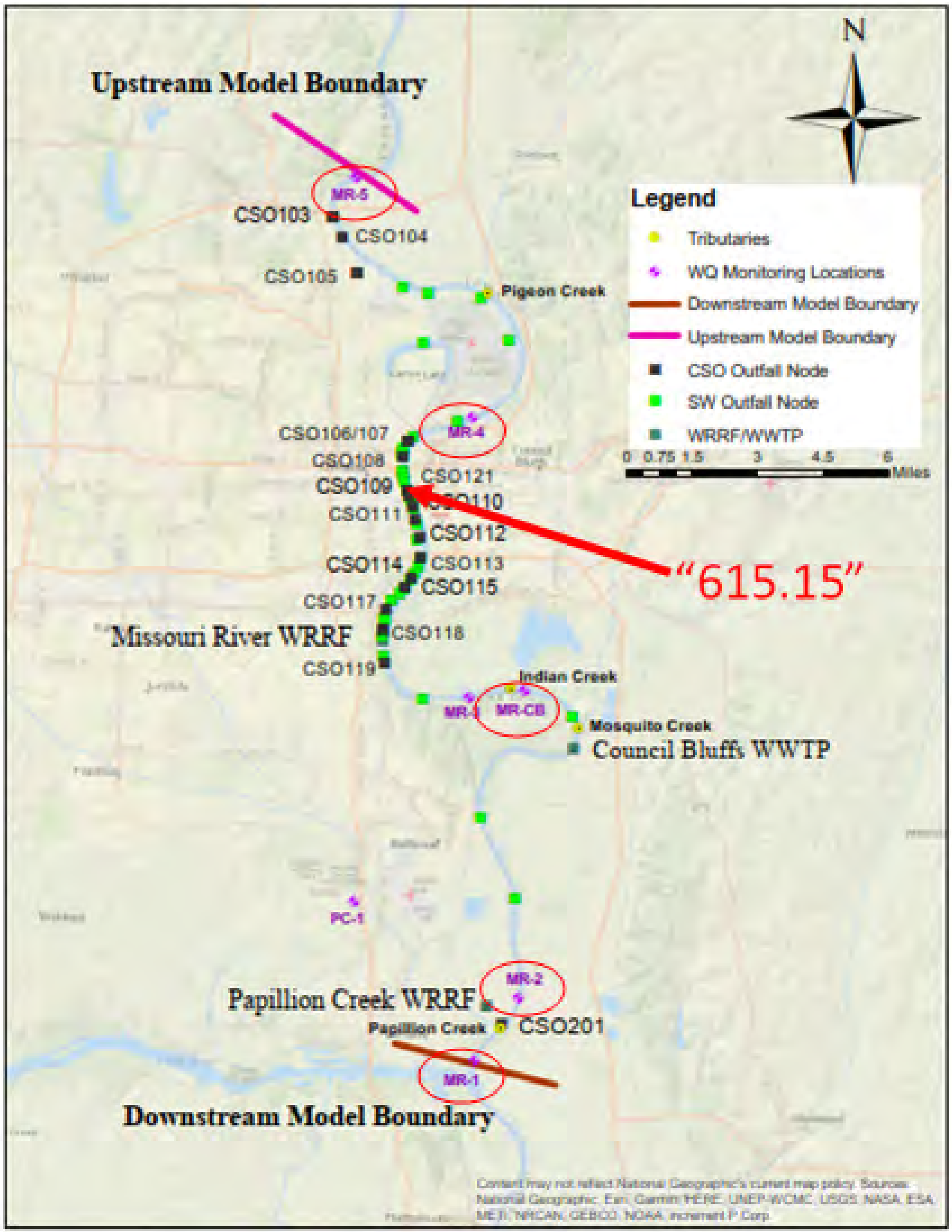

FIGURE 5-11
Missouri River Model Extent and Output Locations
Note: Cross section "615.15" is just downstream of CSO 109

Table 5-9 shows the modeling results for the Missouri River under 2002 Existing Conditions, before the implementation of the LTCP. For the Missouri River model, the assumed *E. coli* concentration for Papillion Creek is 460 cfu/100 mL for dry weather and 43,520 cfu/100 mL for wet weather. The modeling shows that the *E. coli* geometric mean of the whole Missouri River reach is 130 cfu/100 mL, which is above the water quality standard. Of note is the decrease in *E. coli* between cross sections MR-CB and MR-2. The reason for this is that the MR-2 cross section is a significant distance downstream of the last CSO outfall, and there is notable decay in *E. coli* between these cross sections.

TABLE 5-9
Missouri River Existing Conditions *E. coli* Concentrations (cfu/100 mL) based on the 2004 Recreation Season River Flows

Cross Section	May	June	July	August	September	Overall
Whole River	144	137	129	125	116	**130**
MR-5	137	134	132	130	124	**131**
MR-4	134	128	124	123	116	**125**
615.15[a]	148	141	133	129	123	**134**
MR-CB	150	142	131	124	115	**132**
MR-2	140	132	120	113	107	**122**
MR-1	150	144	128	118	111	**129**

[a] Cross section 615.15 is just below CSO 109 (see Figure 5-11).

Table 5-10 shows the modeling results when the LTCP controls are in place in 2037. As with Table 5-9, for the Missouri River model, the assumed *E. coli* concentration for Papillion Creek is 460 cfu/100 mL for dry weather and 43,520 cfu/100 mL for wet weather; therefore, the *E. coli* concentrations do not reflect implementation of the Papillion Creek Total Maximum Daily Load (TMDL)[2] established by NDEE. The modeling shows that, by using the method that NDEE uses to determine if a stream is meeting the water quality standard, the geometric mean for the whole reach is 119 cfu/100 mL, which meets the standard. This would suggest that the controls included in the LTCP can be presumed to achieve the water quality standard for *E. coli*.

TABLE 5-10
Missouri River LTCP *E. coli* Concentrations (cfu/100 mL) based on the 2004 Recreation Season River Flows

Cross Section	May	June	July	August	September	Overall
Whole River	127	121	119	117	111	**119**
MR-5	137	134	132	130	124	**131**
MR-4	127	122	120	119	114	**120**
615.15	128	120	120	120	116	**121**

[2] Total Maximum Daily Loads for the Papillion Creek Watershed (Segments MT1-10100, MT1-10110, MT1-10111, MT1-10111.1, MT1-10120 and MT1-10200) Parameter of Concern: *E. coli* Bacteria, Nebraska Department of Environmental Quality Planning Unit, Water Quality Division, October 2009.

TABLE 5-10
Missouri River LTCP *E. coli* Concentrations (cfu/100 mL) based on the 2004 Recreation Season River Flows

Cross Section	May	June	July	August	September	Overall
MR-CB	126	117	115	114	108	**116**
MR-2	118	108	106	104	100	**107**
MR-1	127	122	114	109	104	**115**

Table 5-11 provides the water quality results for Papillion Creek and its tributaries for both the 2002 Existing Conditions and after implementation of the LTCP in 2037 (It was assumed that the SCRTB was not functioning in hybrid mode, so it was only treating a maximum of 160 MGD). This shows that implementation of the LTCP does not result in the Papillion Creek and its tributaries achieving the *E. coli* standard. It should be noted that in 2037, the only remaining CSO discharges in the PCW are expected to be from CSO 204 (to Cole Creek) and CSO 205 (to Little Papillion Creek).

TABLE 5-11
Papillion Creek Tributaries *E. coli* Concentrations (cfu/100 mL) for 2002 Existing Conditions and after the LTCP is in Place

Stream	2002 Existing Conditions	LTCP Controls
Cole Creek	2999	2064
Little Papillion Creek	5937	4189
Big Papillion Creek	5961	5108
Papillion Creek	4081	3706

Also evaluated was the impact that the Papillion Creek TMDL would have on the *E. coli* levels in the Papillion Creek tributaries and the Missouri River. Table 5-12 provides the results of the incorporation of the *E. coli* targets in the TMDL and their effect on the receiving streams. In addition to confirming that the remaining CSOs would not preclude the Papillion Creek tributaries from achieving the standard, the remaining CSO volumes were set to zero in the Papillion Creek Model.

TABLE 5-12
Papillion Creek Tributaries *E. coli* concentrations (cfu/100 mL) after the LTCP and TMDL

Cross Section	TMDL Stream Targets	LTCP with TMDL	No CSO volume with TMDL concentrations
Cole Creek	82	204	202
Little Papillion Creek	92	197	180
Big Papillion Creek	112	193	180
Papillion Creek	102	190	180

The water quality model results in Tables 5-11 and 5-12 suggest that Papillion Creek tributaries did not meet the *E. coli* water quality standard under Existing Conditions (2002). Consistent with results in the 2009 LTCP and the 2014 LTCP Update, the controls included in the 2021 LTCP Update will not result in Papillion Creek or its tributaries achieving compliance with the standard, despite a significant reduction in the *E. coli* load from the CSOs. Based on the modeling results for Papillion Creek after implementation of the LTCP and TMDL, it still will not achieve the water quality standard for *E. coli*—even if the remaining CSO volumes are set to zero—which confirms that the CSO controls do not preclude the standards for *E. coli* from being met in the PCW. It will be necessary for NDEE to address other pollution sources outside of the CSO Program and likely outside of the City of Omaha to bring the streams into compliance.

Table 5-13 provides the impact on the Missouri River when the concentration for Papillion Creek is set at the TMDL target of 102 cfu/100 mL in the model. This results in reduced *E. coli* levels at MR1, which is below the creek's confluence with the Missouri River; all other Missouri River reaches, including the whole river, have the same overall concentrations (compared to Table 5-10).

TABLE 5-13
Missouri River *E. coli* Concentrations (cfu/100 mL) after Implementation of the LTCP CSO Controls and Papillion Creek Watershed TMDL, based on the 2004 Recreation Season River Flows

Cross Section	May	June	July	August	September	Overall
Whole River	127	120	118	117	111	**119**
MR5	137	134	132	130	124	**131**
MR4	127	122	120	119	114	**120**
615.15	128	120	120	120	116	**121**
MR-CB	126	117	115	114	108	**116**
MR2	118	108	106	104	100	**107**
MR1	116	107	104	102	99	**106**

5.5.2.1 CSO Pollutant Reductions

As CSO volumes are reduced, CSO pollutant loadings also will be reduced. In the MRW, it was estimated that the *E. coli* load to the Missouri River will be reduced by 85 percent under representative year precipitation conditions after implementation of 2021 LTCP Update CSO controls. In the PCW, it was estimated that the *E. coli* load to the watershed will be reduced by 71 percent for the representative year. Table 5-14 summarizes the CSO pollutant reductions.

TABLE 5-14
E. coli Loads in Representative Year

Watershed	Existing Conditions Load (cfu)	2021 LTCP Update Load (cfu)	2021 LTCP Update Load Reduction (%)
Missouri River	9.37E+16	1.38E+16	85%
Papillion Creek	1.97E+16	0.57E+16	71%

As noted in the 2009 LTCP and the 2014 LTCP Update, these load reductions can be lower than the CSO volume reductions for the watersheds for several reasons:

1. Sewer separation results in a reduction in the volume of combined sewage entering the system. However, stormwater has relatively high *E. coli* concentrations, and thus it still provides significant *E. coli* loading to the receiving streams.

2. Increasing flows to the MRWRRF and PCWRRF results in a decrease in the volume of untreated combined sewage that is discharged; however, there is still an *E. coli* loading from the treated discharges at the WRRFs.

3. Combined sewage that is treated in one of the RTBs is included in the "volume captured" calculations. However, the discharge from these systems still results in an *E. coli* loading to the streams. For the PCW, the volume treated by the SCRTB is based on a flow of 160 MGD; however, it can disinfect flows of 320 MGD.

Figure 5-12 is a graphical summary of the *E. coli* loading reductions over time. Approximately half of the loading from CSOs has been reduced so far in the CSO Program.

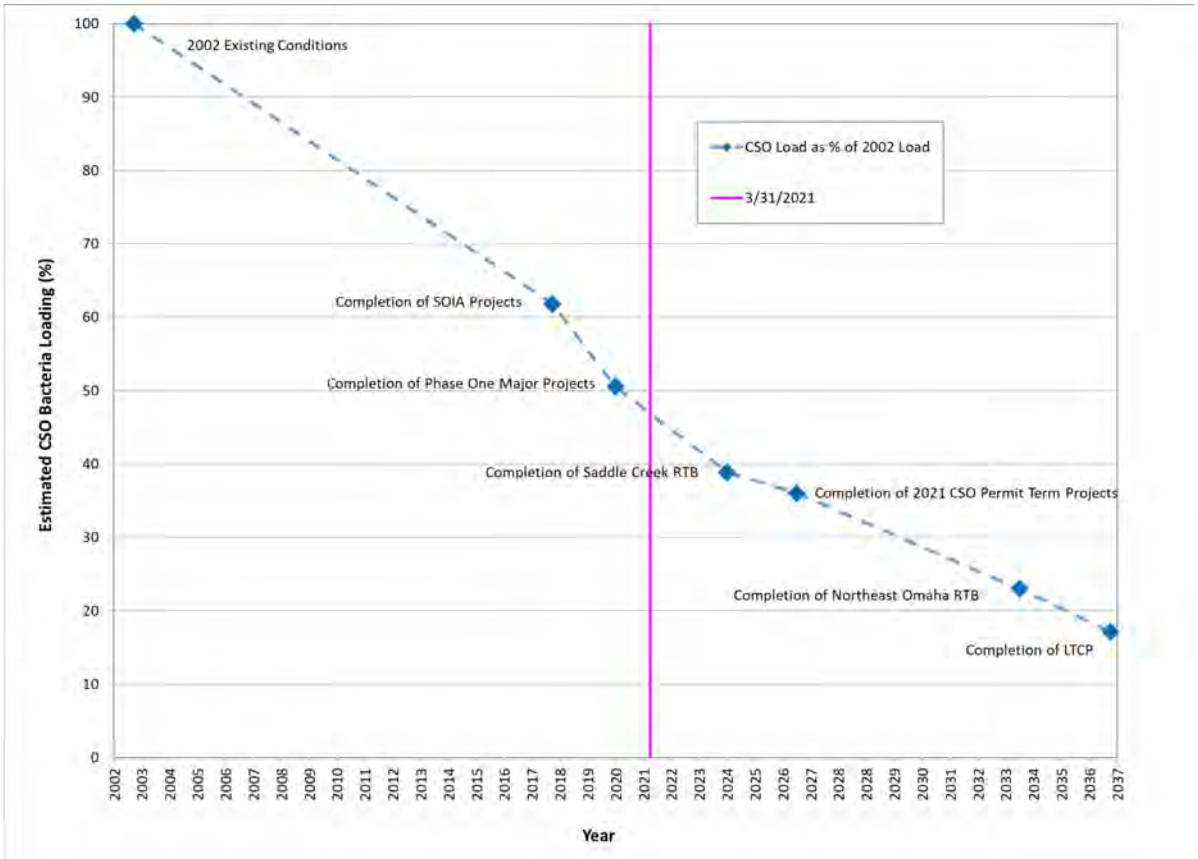

FIGURE 5-12
Estimated Reductions in CSO *E. coli* Load Over Time

5.5.3 Summary of Control Approach

As the preceding sections have detailed, Omaha's 2021 LTCP meets the criteria of the Presumption Approach, summarized as follows:

- The criterion of capturing at least 85 percent of volume during wet weather is achieved under representative year precipitation.
- The Missouri River Water Quality Model shows that water quality standards for *E. coli* can be attained in the Missouri River.
- The Papillion Creek Water Quality Model shows that, while Papillion Creek and its tributaries are not expected to achieve attainment of water quality standards upon completion of the implementation of the LTCP, it can be presumed that achievement of the *E. coli* standard will not be precluded by the CSOs.

5.6 Summary and Conclusions

The information in this section summarized the changes in the controls in the 2021 LTCP Update from the 2009 LTCP and 2014 LTCP Update. It shows that the changes comply with the CSO Permit, Consent Order, and the EPA CSO Control Policy.

Section 5.3 provides a comparison of the 2009 LTCP controls, 2014 LTCP Update controls, and those proposed in this 2021 LTCP Update. As noted, because of the Optimization Evaluation there are significant changes in the controls for the MRW. The changes in the PCW are less significant and are focused on CSO 204 and a reduction in the size of the SCRTB.

Tables 5-1 through 5-4 provide a summary of the projects that have been completed, removed, or added to the LTCP. The following is a list of the projects that have been removed:

- CSO Deep Tunnel
- CSO Tunnel Lift Station and Force Main
- RTB at MRWRRF
- RTB Dewatering Lift Station
- Bridge Street Lift Station and Force Main
- Minne Lusa Stormwater Conveyance Sewer and associated sewer separation projects
- Phase 1 and 2 Storage Facility at CSO 105 – Minne Lusa
- CSO 204 Storage Tank
- CSO 204 Phase 2
- CSO 204 Phase 5
- CSO 210 Inflow Reduction
- CSO 211 Inflow Reduction
- Webster and Nicholas Phase 2

The following are new projects that have been added:

- East Cole Creek Interceptor Rehabilitation
- Minne Lusa Relief Sewer Diversion Modifications
- 61st and Radial Storm Sewer
- Grace St and North Interceptor DWF Diversion Rehabilitation
- CSO 105 Outfall Active Control
- North Downtown Conveyance Sewer - 11th and Izard to 6th and Abbott
- 11th and Izard Grit and Screening Facility
- 11th and Izard Active Control
- Northeast Omaha RTB - 6th Street and Abbott Drive
- 21st and Cuming Active Control
- Leavenworth Basin Storage Tank (CSO 109)

In addition, while still in the LTCP, it is anticipated that the Hickory Street Sewer Separation and the Pierce Street Sewer Separation projects may be replaced or removed from the LTCP as the result of an evaluation of the need to reduce flows into the Leavenworth Lift Station.

In addition, the City is establishing an I/I Reduction Program that will address wet weather impacts after completion of sewer separation. This potentially could include inflow reduction in the CSO basins serving CSO 202, CSO 203, CSO 204, CSO 208, CSO 210, CSO 211, CSO 212, and potentially other CSO basins in the MRW. It is not anticipated that inflow reduction will be necessary in all CSO basins. The goal of the program will be to achieve the anticipated CSO deactivation committed to in the 2021 LTCP Update.

The revised total estimated cost of the Program is $1,998,952,000, or approximately $2 billion, which is a reduction from the 2014 LTCP Update. Table 5-5 provides the breakdown of the costs.

Compliance with the 85 percent wet weather volume capture criterion is discussed in Section 5.5. This section provides the results of the collection system modeling and water quality modeling. Table 5-7 shows that the wet weather volume capture of the MRW will be 85 percent during the representative year once all controls are completed. For the PCW, the wet weather volume capture is 97 percent (Table 5-8). As noted in Table 5-10, the water quality standard on the Missouri River should be met with the implementation of the controls, and Tables 5-11 and 5-12 show that meeting the water quality standard will not be precluded in the Papillion Creek tributaries.

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6 LTCP Schedule

6.1 Introduction

This section includes a revised Long Term Control Plan (LTCP) schedule and describes significant scheduling assumptions. The 2021 LTCP Update schedule was developed in conjunction with schedules being developed for modifications to the City of Omaha's (City's) water resource recovery facilities (WRRFs). Unlike the previous LTCP documents, the schedule being proposed does not include phases for projects nor does the schedule categorize projects as "Major Projects" or "Sewer Separation Projects." The LTCP schedule milestones are based on the completion date of construction for each of the remaining LTCP projects.

6.2 Schedule Development

The City has updated the CSO LTCP, developed the WRRF Master Plan, and created an asset management strategy for the collection system to consistently maintain the system and prioritize needed improvements. Since 2009, the City has tended to prioritize the CSO Program projects over other needs of the existing infrastructure at the WRRFs and the collection system due to the regulatory drivers associated with the CSO Program. The 2021 LTCP Update schedule was developed in an integrated manner with the WRRF Master Plan and the collection system priorities. Elements that were factors in the development of the 2021 LTCP Update schedule include the following:

1. The City is committed to significant capital expenditures over the next 20 years to not only meet CSO requirements, but to also make the necessary improvements to the WRRFs and the collection system. Like the LTCP, the WRRF Master Plan provides the City with a roadmap of projects, which are intended to allow the City to maintain regulatory compliance. The anticipated expenditures will address concerns with existing infrastructure as well as continue the path toward meeting future regulatory requirements.

2. The City has made significant investments in the combined sewer system (CSS) over the last 15 years in the context of the CSO Program. Over the next 5 or more years, the City intends to review the collection system with the goal of maximizing the operations of these new systems before pushing forward with the final facilities in the CSS. This includes the development and implementation of a real-time control (RTC) system and

cost effective strategies that aim to maximize use of the current system. The City will continue to implement CSO projects and will finish 8 of the remaining 13 sewer separation projects during the first 5 years of the 2021 LTCP Update schedule. The maximization of operations will set the stage for both the design and construction of the remaining CSO controls and ensure that that new facilities are properly sized.

3. Allowing time to verify performance controls and other improvements before moving forward with additional investment was factored into the schedule. This was incorporated into the CSO Schedule as well as the proposed WRRF improvements, especially when implementing new technologies. For example, the City will factor the lessons learned from the current operation of the CSO 102 Chlorine Contact Basin, and the construction and future operation of the Saddle Creek Retention Treatment Basin (SCRTB), which is anticipated to be complete in 2023, to make final decisions on the Northeast Omaha Basin RTB. Based on experience with operation of these facilities, in 2025 the City will start implementing the chosen approach or shift to other alternatives that achieve the same goals. For the WRRFs, this means that implementation of technologies new to the City staff will be done in phases to allow for lessons to be learned before moving forward with the next phase.

4. Progress will continue under the CSO Program. During the next CSO Permit term, all existing CSO projects in the Papillion Creek Watershed (PCW) will be under design, under construction, or completed. These projects include CSO 202 Phase 2 - 70th Avenue and Spencer Street, Cole Creek CSO 203 Sewer Separation Project (CSO), CSO 204 Phases 3 and 4 Sewer Separation, Papillion Creek North (PCN) 210 Sewer Separation, CSO 212 - 64th Avenue and William Street and the SCRTB at 64th & Dupont (CSO 205). In addition, in the Missouri River Watershed (MRW), current projects including Forest Lawn Creek Inflow Removal and Outfall Storm Sewer, Nicholas Street Sewer Extension - Phase 3B, and the CSO 119 South Barrel Conversion & Sewer Separation projects will be completed during this time. Completion of the lift station improvements at the Monroe Street, Burt-Izard, Riverview, and Blake Street Lift Stations over the next several years will result in the ability to maximize the flow to the MRWRRF during wet weather. The completion of these projects sets the stage for the final push for completion of the LTCP, which will include the construction of the new projects starting with the 2026 CSO Permit renewal.

In developing the LTCP Update Schedule, the City overlaid the Capital Improvements Plan (CIP) for the LTCP with those for the WRRFs and the collection system to ensure that the plan can be implemented in terms of the City's Rate Model as well as availability of consulting engineers and contractors. The Combined CIP for the 2021 LTCP Update, WRRF Master Plan, and Collection System is shown on Figure 6-1.

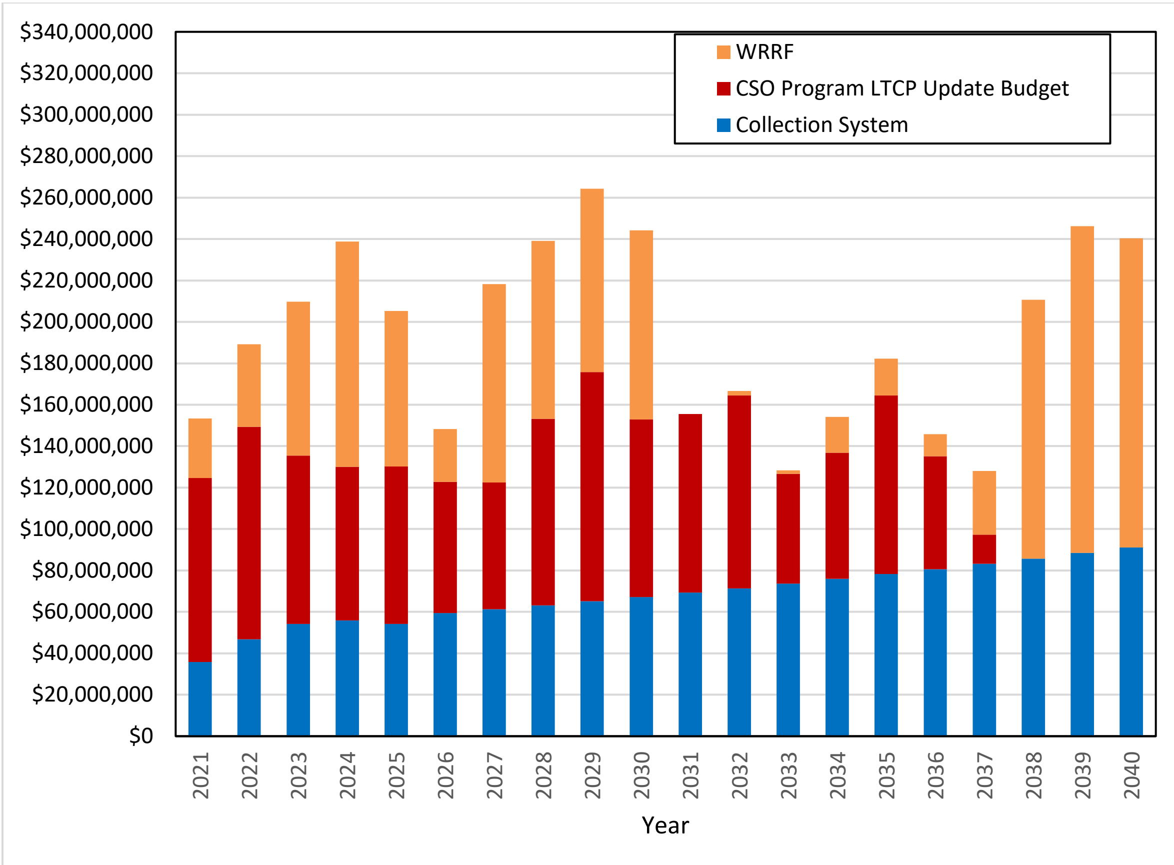


FIGURE 6-1
Combined CIP for the 2021 LTCP Update, WRRF Master Plan and Collection System

Figure 6-2 provides a breakdown of the anticipated CIP for the implementation of the LTCP over the next 16 years. The “New LTCP Projects” on Figure 6-2 are those that are new under this 2021 LTCP Update, and include the following:

- East Cole Creek Interceptor Rehabilitation
- Minne Lusa Relief Sewer Diversion Modifications
- 61st and Radial Storm Sewer
- Grace St and North Interceptor DWF Diversion Rehabilitation
- CSO 105 Outfall Active Control
- North Downtown Conveyance Sewer - 11th and Izard to 6th and Abbott
- 11th and Izard Grit and Screening Facility
- 11th and Izard Active Control
- Northeast Omaha RTB - 6th Street and Abbott Drive

- 21st and Cuming Active Control
- Leavenworth Basin Storage Tank (CSO 109)

The “Current LTCP Projects” include those that have not changed. These are as follows:

- Cole Creek CSO 204 Area – Phase 3 Combined Sewer Separation (Taylor to Ruggles Between 56th and 61st)
- Papillion Creek North (PCN) 210 Sewer Separation
- Cole Creek CSO 203 Sewer Separation Project (CSO)
- Saddle Creek Retention Treatment Basin
- Forest Lawn Creek Inflow Removal and Outfall Storm Sewer
- CSO 212 - 64th Avenue and William Street
- Nicholas Street Sewer Extension - Phase 3B
- CSO 119 South Barrel Conversion and Sewer Separation
- CSO 202 Phase 2 - 70th Avenue and Spencer Street
- CSO 204 Phase 4a - 57th Street and Pratt Street
- CSO 204 Phase 4b - 56th Street and Bedford Avenue
- Jones Street to Leavenworth Diversion
- Hickory Street Sewer Separation
- Pierce Street Sewer Separation

The “Other LTCP Budgets” include ongoing costs including, but not limited to, the Infiltration and Inflow (I/I) Reduction Program and flow monitoring. The budget is discussed in more detail in Section 5.

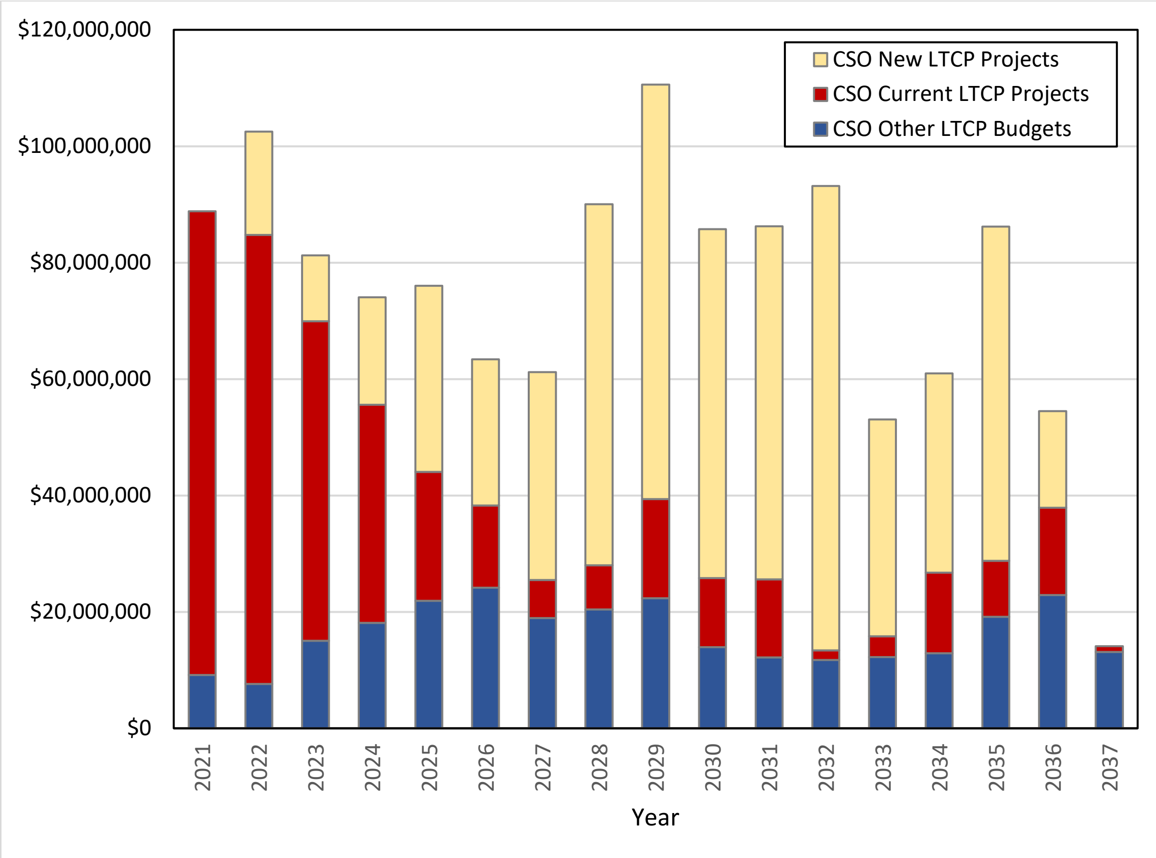


FIGURE 6-2
2021 LTCP Update Capital Improvements Plan

6.3 LTCP Schedule

In the 2009 LTCP there were approximately 90 projects included in the schedule. In the 2014 LTCP Update this number was revised down to 59 projects, including completed projects and reductions through the combining, eliminating, or pooling of projects. In both the 2009 LTCP and 2014 LTCP Update, the schedule was organized in seven phases for Sewer Separation and four phases of Major Projects. This has worked well and provided the City with flexibility needed at the time. However, the City has made significant progress and phases are no longer needed. There are 29 projects in this 2021 LTCP Update to be delivered over the next 16 years, which includes four lift station projects that are related to system reliability and do not have specific schedules. Of the 29 projects, 9 of the LTCP Projects and all 4 of the reliability projects are anticipated to be complete during the 2021 to 2026 CSO Permit term. The City has developed the schedule based on construction completion dates for individual projects (which are defined as “substantially complete” for sewer separation projects and “operationally complete” for facility projects). Figure 6-3 provides a graphical layout of the construction completion dates of the 2021 LTCP Update projects, including newly proposed projects, for each of the remaining years of LTCP implementation. Table 6-1 provides the list of project milestone dates for completion of projects proposed to be included in the CSO Permit that covers the period from

October 1, 2021, to September 30, 2026. Table 6-2 provides the anticipated project completion milestones for the remaining 20 projects proposed for inclusion in subsequent CSO Permits. The City has developed project delivery schedules for all projects that can be shared with NDEE if desired.

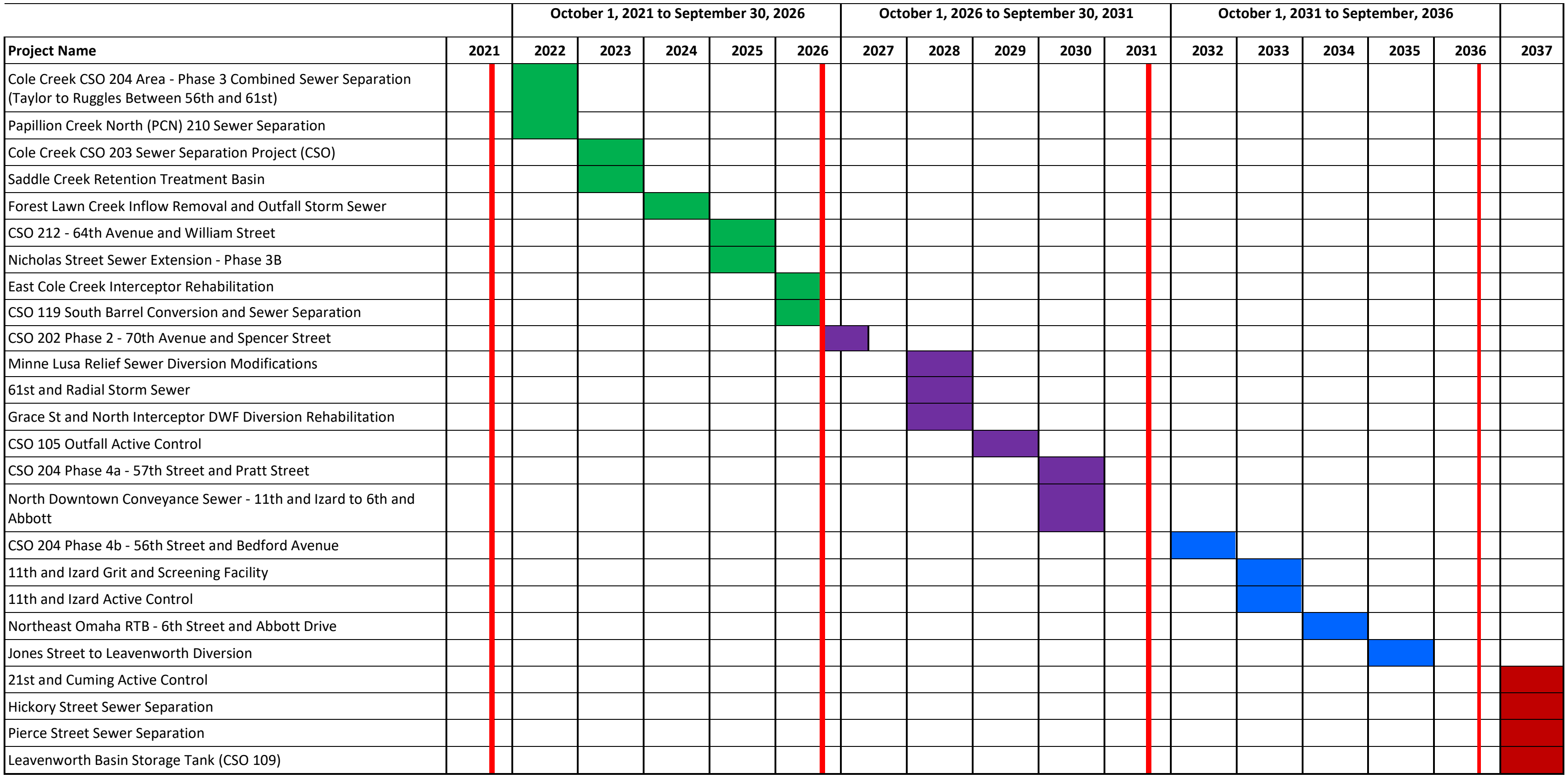


FIGURE 6-3
2021 LTCP Update Project Schedule

TABLE 6-1
LTCP Project Construction Completion Dates for the October 1, 2021 to September 30, 2026 Permit

Project Name	Milestone Date
Cole Creek CSO 204 Area – Phase 3 Combined Sewer Separation	6/30/2022
Papillion Creek North (PCN) 210 Sewer Separation	12/31/2022
Cole Creek CSO 203 Sewer Separation Project (CSO)	12/31/2023
Saddle Creek Retention Treatment Basin	12/31/2023
Forest Lawn Creek Inflow Removal and Outfall Storm Sewer	12/31/2024
CSO 212 - 64th Avenue and William Street	6/30/2025
Nicholas Street Sewer Extension - Phase 3B	6/30/2025
East Cole Creek Interceptor Rehabilitation	6/30/2026
CSO 119 South Barrel Conversion and Sewer Separation	6/30/2026

TABLE 6-2
LTCP Project Construction Completion Dates for Future Permits – October 1, 2026 and later

Project Name	Milestone Date
CSO 202 Phase 2 - 70th Avenue and Spencer Street	12/31/2026
Minne Lusa Relief Sewer Diversion Modifications	6/30/2028
61st and Radial Storm Sewer	12/31/2028
Grace St and North Interceptor DWF Diversion Rehabilitation	12/31/2028
CSO 105 Outfall Active Control	6/30/2029
CSO 204 Phase 4a - 57th Street and Pratt Street	6/30/2030
North Downtown Conveyance Sewer - 11th and Izard to 6th and Abbott	6/30/2030
11th and Izard Grit and Screening Facility	6/30/2033
CSO 204 Phase 4b - 56th Street and Bedford Avenue	12/31/2032
11th and Izard Active Control	6/30/2033
Northeast Omaha RTB - 6th Street and Abbott Drive	6/30/2034
Jones Street to Leavenworth Diversion	12/31/2035
21st and Cuming Active Control	6/30/2037
Hickory Street Sewer Separation	6/30/2037
Pierce Street Sewer Separation	6/30/2037
Leavenworth Basin Storage Tank (CSO 109)	6/30/2037

The projects included in Tables 6-1 and 6-2 are discussed in Section 5. These schedules have been developed based on the current status of the projects, the City's financial capabilities, and other needs of the City. One lesson learned over the last 15 years is that unanticipated events will occur that will require modifications to this schedule. It is difficult to provide precise dates for implementation of projects 10 or more years in the future. It is possible that the completion dates for projects after 2026 may be adjusted in future LTCP Updates.

6.4 Factors Affecting Schedule

Several factors could impact the ability to meet the LTCP schedule presented in this LTCP Update. These factors are like the ones that were identified in the previous LTCPs. They include uncertainty in project funding, affordability of rate increases, fluctuation in project costs, fluctuation in labor and material markets, changes in construction standards and legal requirements, unknown physical conditions in the soils or rock, unforeseen demographic and infrastructure changes, unanticipated limitations in construction capacities locally, inability of utilities to design or relocate their facilities in a timely manner, changes in National Pollutant Discharge Elimination System (NPDES) permit requirements, changes in water quality standards, or other unforeseen problems such as a *force majeure* event. These factors could affect the schedules of individual projects as well as the City's ability to complete implementation of the plan by 2037.

The 2021 LTCP Update schedule is based on information currently available to the City, and on experience with implementing the LTCP projects since 2009. Efforts have been made to evaluate, account for and, as appropriate, mitigate factors that could result in delays in the implementation of the projects. During implementation of the LTCP Update, the City will identify any concerns with the schedule provided, and over the next 16 years, there will likely be unanticipated situations that will affect the City's ability to meet the schedule. The City will continue to work closely with Nebraska Department of Environment and Energy (NDEE) and United States Environmental Protection Agency (EPA) to keep them informed of these situations in addition to specific project schedules.

The 2021 LTCP Update schedule is based on current regulations and guidance and several assumptions. Regulations and guidance include the Clean Water Act (CWA), the 1994 EPA CSO Control Policy, EPA guidance on CSOs and performing water quality standard reviews and revisions, and the State of Nebraska Water Quality Standards. Changes to any of the regulations or guidance or the following assumptions may support a request for modification of the 2021 LTCP Update and implementation schedule. Assumptions include the following:

1. NPDES permits issued for the CSS, Missouri River Water Resource Recovery Facility (MRWRRF), Papillion Creek Water Resource Recovery Facility (PCWRRF), or the separate stormwater system will not contain schedules or requirements that result in significant redirection of City resources.
2. Any future judicial or administrative orders will be consistent with the current Consent Order.
3. The financial capability of the City will remain equal to or better than that indicated in the financial capability assessment in the 2021 LTCP Update. Refer to Section 4 of this report for additional discussion related to affordability concerns.

4. The City's bond rating will not be significantly lower than that indicated in the financial capability assessment in the 2021 LTCP Update, and the interest rate for bonding will not be higher than that indicated in the financial capability assessment, as documented in Section 4.
5. All approvals and permits can be obtained in reasonable periods. Experience on projects implemented thus far indicates that this can be a challenging area requiring significant effort and diligence.
6. Data and information collected, and studies performed do not result in the need to significantly revise the CSO controls. Several of the projects identified in this LTCP Update have only been developed at a conceptual/planning level to obtain an initial budget and expectation of performance. Specifics such as interceptor alignments, easements and property acquisitions, facility siting, and others have not been completed in some cases. More detailed facility plans will be developed based on the collection of additional information and the performance of additional engineering evaluations. This includes but is not limited to soil borings, hydraulic design, functional design, system operational design, interaction and interface studies, configuration design, coordination with other utilities, and geotechnical investigations. Based on the results of the investigations and studies, findings may require revisions to time requirements and project schedules.
7. Acquisition of land and obtaining easements or rights to use land from private landowners, the Nebraska Department of Transportation (NDOT), Union Pacific Railroad (UPRR), BNSF Railway Company, Omaha Public Power District (OPPD), and Metropolitan Utilities District (M.U.D.) will not cause delays to projects. As with permits, experience on projects thus far indicates that the cost, schedule, and effort associated with easements and property acquisitions are greater than originally anticipated.
8. Landowners will allow temporary construction access without unreasonable restrictions to perform investigations, surveys, and construction.
9. The technical basis related to construction conditions and technology for construction of the CSO control facilities will not change significantly.
10. The typical timeframe between bid opening of any project and the start of construction will be consistent with assumptions made in schedule development. This timeframe has been lengthened somewhat from what was originally assumed in the 2009 LTCP based on project experience. Delays could be due to challenges to the bid, delay of bid award, delays in utility relocations by others, or other factors.
11. Potential regulations of the state or federal government that impact siting, operation, or other functional requirements of the CSO control facilities will not require significant changes to the LTCP.
12. The actual costs of the CSO control projects (based on construction bids or conditions encountered during construction) will not change significantly from the costs assumed at this time, and therefore will not counter the findings of the current financial capability analysis.
13. Technical, legal, and institutional conditions will not require significantly more time than anticipated or planned. This could include requirements of governmental entities related to technical or legal procedures or guidelines that impact the process of completing the design or construction of a project.

14. Development or redevelopment projects in the combined sewer area will be limited to those currently identified.
15. Revisions to street improvement project schedules will be minimal.
16. All local utilities will work with the City in a cooperative manner and have sufficient staff to provide timely field verification, design, and construction relocation of their facilities (or allow others to do so) for the remaining sewer separation projects.
17. There is sufficient availability and capacity of qualified construction contractors to meet the project schedules and provide competitive bids.
18. The ability of material manufacturers and suppliers to deliver materials in a timely manner does not significantly affect the duration and cost of construction. Increased delivery times, as result in part due to the COVID-19 pandemic, has already impacted the cost of projects and the construction schedules of certain projects.
19. Existing sewer infrastructure conditions will remain about the same and there will be no unanticipated failures that cause a redirection of time or resources. Infrastructure needs are managed by the City through risk-based asset management programs with the goal of ensuring that there is reliable infrastructure to support adjoining or interdependent CSO Program LTCP projects.
20. No further *force majeure* events will take place such as the flooding that occurred in 2011 and 2019.
21. Affordability discussions with NDEE will not result in significant changes to project schedules.

6.5 Summary and Conclusions

The LTCP Schedule was developed in an integrated manner incorporating other City infrastructure needs for the treatment system and collection system. This has allowed the City to address other regulatory requirements and infrastructure needs while continuing to implement the LTCP.

The approach to the 2021 LTCP schedule has changed from 2009 LTCP and 2014 LTCP. These LTCPs included schedules with seven phases of Sewer Separation and four phases of Major Projects. This has worked well and provided the City with flexibility. However, because of the progress the City has made, the 2021 LTCP Update includes only 29 projects, including 4 that are system reliability projects that do not have specific schedules. Of the remaining 29 projects, 9 of the LTCP Projects and all 4 of the reliability projects are anticipated to be complete during the 2021 to 2026 CSO Permit term, 12 of which are under design or construction or will be by October 1, 2021. The City is proposing that the schedule milestones be based on only the construction completion dates (substantially complete for sewer separation projects and operationally complete for facility projects).

The ability to meet the LTCP schedule is based on various factors as noted in Section 6.4. The City will continue to work with the NDEE regarding any unforeseen circumstances that occur over the course of implementation.

7 Public Involvement

This section of the Long Term Control Plan (LTCP) Update summarizes the activities that have taken place to fulfill both the United States Environmental Protection Agency (EPA) combined sewer overflow (CSO) Control Policy and the CSO permit requirement to continue to employ a public participation process, and provides insight into the activities conducted by the City of Omaha (City) related to the LTCP. The specific regulatory requirements are as follows:

The EPA CSO Control Policy states:

> "2 Public Participation:
>
> In developing its long-term CSO control plan, the permittee will employ a public participation process that actively involves the affected public in the decision-making to select the long term CSO controls. The affected public includes rate payers, industrial users of the sewer system, persons who reside downstream from the CSOs, persons who use and enjoy these downstream waters, and any other interested persons."

In addition, the CSO permit states in Part V. B. Public Participation Plan:

> "A public participation strategy that was used throughout the LTCP development and implementation is included in Section 5 of the [2009] LTCP Public Participation Process. The City of Omaha shall continue to employ a public participation process throughout implementation of the LTCP and document public participation activities in the CSO Annual Report."

The requirements for public involvement in the EPA CSO Policy was achieved as part of the development of the original LTCP in 2009. The focus changed in the 2014 LTCP from public involvement to one of public participation and public outreach. Public outreach by Clean Solutions for Omaha, the name commonly used with the general public for the CSO Program, has evolved since 2014, the details of which are shared throughout this LTCP Update. It now extends beyond the usual public meeting strategies to encompass neighborhood meeting engagement and virtual meetings. Outreach to stakeholders is multi-channeled, including the Program public website (www.OmahaCSO.com), social media messaging, newsletters that connect projects and stakeholders, informational displays in public spaces, the CSO Quarterly Report, a monthly Snapshot, contractor events to encourage small and emerging small businesses, and youth-centered education and events.

During 2020, the public outreach strategy has pivoted from in-person to virtual meetings, video presentations about projects, e-newsletters, expanded social media, and online learning activities to engage students. In some ways, these strategies have changed the paradigm, making it possible for people to engage when they have time to listen and respond, rather than taking time away from work or family to attend a meeting.

In 2021, public outreach will reach out to target audiences with specific information about the updates in this CSO LTCP document. Public outreach is foundational to the success of public acceptance for the City's Program and it will continue to evolve and educate as this LTCP is executed.

7.1 Public Involvement Overview

The City is required to develop and implement the Public Participation Program to foster community acceptance. It is one of three goals along with economic affordability and regulatory compliance set by the City in 2006 when the study phase of the plan began. Public participation focuses on the following major efforts:

- Inform, educate, and engage the public about the CSO Program and its projects
- Build trusted relationships in the community that lead to public acceptance
- Communicate to stakeholders on the progress of specific projects within the LTCP
- Convey the benefits of each project and the Program

The details of these activities and the stakeholders are provided throughout the following sections.

7.1.1 Public Education Efforts

Public education efforts target ratepayers, industrial users of the system, and residents who live within the designated improvement areas. Since the CSO Program began in 2006, the Program has provided education and facilitated input on the progress of the LTCP. More than 125 volunteers participated on Basin Advisory Panels and on a Community Basin Panel during the original planning phase. These groups met regularly until the approval of the initial LTCP in 2010 and for a period after that to discuss the Program implementation.

Ten years later, the City continues to meet with area residents, attend neighborhood and business organization meetings, and keep regular contact with industrial users. Figure 7-1 is an example of an in-person public meeting. It is a priority to hold meetings either in person or virtually with those in the project areas to collect feedback throughout the design process as well as through the construction process. Additionally, public participation recognizes the expanding diversity of the City and provides materials and information in bilingual formats and through bilingual media channels.

FIGURE 7-1
An In-person Public Meeting

The CSO Program is the largest infrastructure program in the City's history and represents an opportunity for public outreach to serve a role in workforce inclusion as part of the Program's Economic Equity and Inclusion Team (EEIT).

In addition, public participation has extended its outreach to youth through schools, youth organizations and the website. The duration of the CSO Program means that many of the middle and high school students reached will soon be ratepayers. In meeting the public acceptance goal, it is important to ensure that the next generation of ratepayers be informed about the LTCP efforts.

7.1.2 Stakeholders

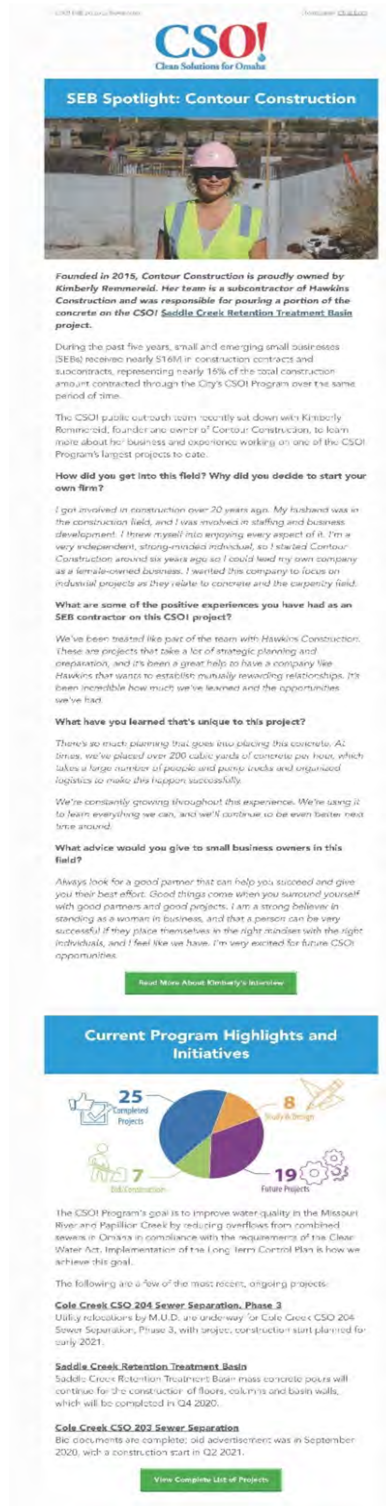
Each category of stakeholders is considered in the public participation planning; this section provides a summary of the engagement and education for these groups.

7.1.2.1 Residential Ratepayers

Residential ratepayers represent the largest number of contributors to financing the LTCP. Public outreach to these stakeholders is both community-wide and project-specific. Residents are kept informed through the Program's connection to neighborhood associations, via email project updates, reports at their regularly scheduled meetings (either in person or virtual), through Program-focused e-newsletters, Figure 7-2 is an example, and by presentations to civic organizations. A ratepayer assistance program, which has been in place since 2011, is communicated widely to provide information about options for financial assistance for qualified ratepayers. This is further discussed in Section 4.

7.1.2.2 Business and Industry

Commercial and industrial ratepayers, particularly about 100 of the largest users, continue to be major stakeholders and pay a significant share of the increased rates. Public education efforts with these stakeholders have extended beyond the expected meeting interactions. Businesses in areas impacted participate in one-on-one discussions during the design and construction phases and are provided with regular updates so they can plan for disruptions, change delivery access, or communicate with customers. The City also provides the quarterly reports and meets, as needed, with a designated group of these stakeholders to provide progress information.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SEB Spotlight: Contour Construction

Founded in 2015, Contour Construction is proudly owned by Kimberly Remmereid. Her team is a subcontractor of Hawkins Construction and was responsible for pouring a portion of the concrete on the CSO! Saddle Creek Retention Treatment Basin project.

During the past five years, small and emerging small businesses (SEBs) received nearly $16M in construction contracts and subcontracts, representing nearly 16% of the total construction amount contracted through the City's CSO! Program over the same period of time.

The CSO! public outreach team recently sat down with Kimberly Remmereid, founder and owner of Contour Construction, to learn more about her business and experience working on one of the CSO! Program's largest projects to date.

How did you get into this field? Why did you decide to start your own firm?

I got involved in construction over 20 years ago. My husband was in the construction field, and I was involved in staffing and business development. I threw myself into enjoying every aspect of it. I'm a very independent, strong-minded individual, so I started Contour Construction around six years ago so I could lead my own company as a female-owned business. I wanted this company to focus on industrial projects as they relate to concrete and the carpentry field.

What are some of the positive experiences you have had as an SEB contractor on this CSO! project?

We've been treated like part of the team with Hawkins Construction. These are projects that take a lot of strategic planning and preparation, and it's been a great help to have a company like Hawkins that wants to establish mutually rewarding relationships. It's been incredible how much we've learned and the opportunities we've had.

What have you learned that's unique to this project?

There's so much planning that goes into placing this concrete. At times, we've placed over 200 cubic yards of concrete per hour, which takes a large number of people and pump trucks and organized logistics to make this happen successfully.

We're constantly growing throughout this experience. We're using it to learn everything we can, and we'll continue to be even better next time around.

What advice would you give to small business owners in this field?

Always look for a good partner that can help you succeed and give you their best effort. Good things come when you surround yourself with good partners and good projects. I am a strong believer in standing as a woman in business, and that a person can be very successful if they place themselves in the right mindset with the right individuals, and I feel like we have. I'm very excited for future CSO! opportunities.

Read More About Kimberly's Interview

Current Program Highlights and Initiatives

The CSO! Program's goal is to improve water quality in the Missouri River and Papillion Creek by reducing overflows from combined sewers in Omaha in compliance with the requirements of the Clean Water Act. Implementation of the Long Term Control Plan is how we achieve this goal.

The following are a few of the most recent, ongoing projects:

Cole Creek CSO 204 Sewer Separation, Phase 3
Utility relocations by M.U.D. are underway for Cole Creek CSO 204 Sewer Separation, Phase 3, with project construction start planned for early 2021.

Saddle Creek Retention Treatment Basin
Saddle Creek Retention Treatment Basin mass concrete pours will continue for the construction of floors, columns and basin walls, which will be completed in Q4 2020.

Cole Creek CSO 203 Sewer Separation
Bid documents are complete; bid advertisement was in September 2020, with a construction start in Q2 2021.

View Complete List of Projects

FIGURE 7-2
E-newsletter Update

7.1.2.3 General Contractors and Small and Emerging Small Business Contractors

The Program's EEIT, which includes a public participation component, is responsible for keeping contractors informed about upcoming bid opportunities. Information is disseminated through the Contractors' Corner on the Program public website, constructability review meetings between 60% and 90% design, pre-bid meetings that outline scopes of work and estimated quantities, direct mail, and email updates. The EEIT also facilitates and encourages interactions between small businesses and general contractors to support expanded opportunities and competitive bids. The EEIT interacts with the City's Human Rights and Relations and Public Works divisions to support diversity and expand inclusion on projects under the Program.

7.1.2.4 Elected Officials

Elected officials, including the Mayor, are key stakeholders because they are often the communication link between their constituents (the Program ratepayers) and the Program. Additionally, elected officials often approve contracts and are responsible for ensuring that the City meets regulatory guidelines. They are provided with updates on a bimonthly basis at their public works subcommittee and a monthly "Snapshot" report provides them with up-to-date project schedules, budgets, and rate assistance so they are well prepared for constituent questions. Figure 7-3 is an example of a Snapshot. In addition, they receive the Annual Report which covers all aspects of the Program as required by the CSO National Pollutant Discharge Elimination System (NPDES) Permit and Consent Order. All the Snapshot, Quarterly and CSO Annual Reports are posted to the website and are available to the public to build trust through transparency.

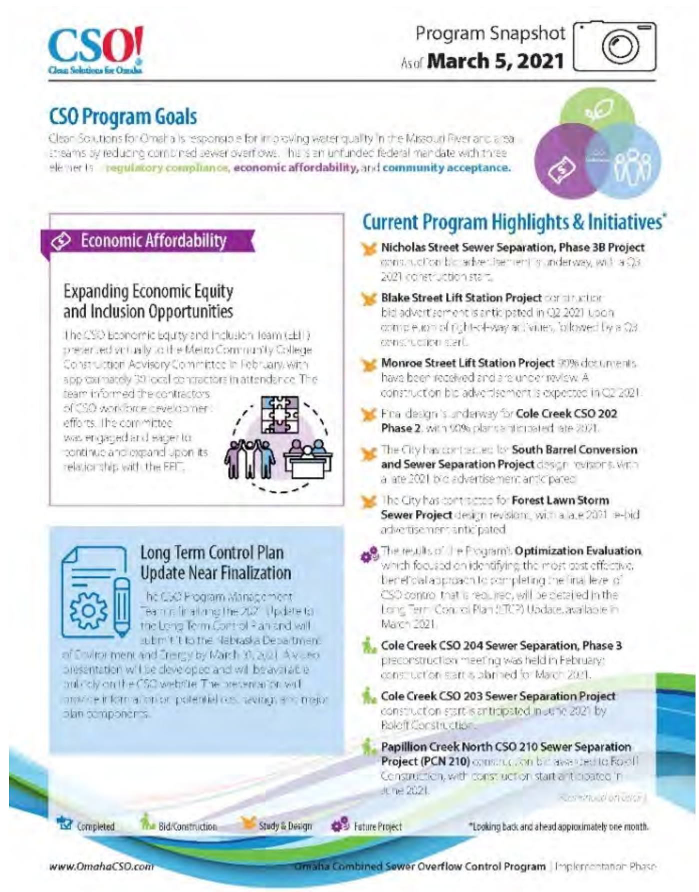

FIGURE 7-3
Program Snapshot Report

7.1.2.5 Youth

Public outreach has extended its education to youth who may eventually become ratepayers, as a way to connect young people with the Program's work to improve water quality, to encourage exploration into related careers, and to elevate the diversity of the workforce. Outreach is focused on environmental benefits, economic impact, and functionality of the City's infrastructure through a series of animations and interactive tools made available to school districts and youth organizations. The Program also supports classroom presentations and provides onsite tours (pre-COVID-19) of projects. Examples include Spring Lake Park and Fontenelle Lagoon. Figure 7-4 is a picture of one of these events at Fontenelle.

FIGURE 7-3
Youth Outreach Event at Fontenelle Park

7.1.2.6 Other Stakeholders

Nearly everyone who uses the regional sewer system is a stakeholder, as a resident, business, or other interested stakeholder. Some examples of other groups included in the Program's outreach are:

- Community/civic/religious entities:
  - Chamber of Commerce
  - Economic development groups
  - Faith-based organizations
  - Environmental organizations
  - Educational and professional groups
  - Universities and colleges
  - Community colleges
  - Labor unions
  - Public and private schools
- Utilities
  - Metropolitan Utilities District (M.U.D.; gas and water)
  - Omaha Public Power District (OPPD)
- Additional City of Omaha departments

7.2 Summary of Past and Future Public Involvement Efforts

7.2.1 Past Efforts

Public participation has been a consistent priority for the CSO Program and is supported by City Public Works, the Mayor's office, and other City departments.

From the basin and community panels, which began in 2006, to the intentional planning for public participation in design and through construction, public participation has led efforts to facilitate public acceptance. Figure 7-5 shows examples of public outreach efforts.

FIGURE 7-4
Public Outreach

As described elsewhere in this LTCP Update, the Program has adapted to intervening factors including 2 years of major flooding and the need to slow ratepayer cost increases; all of which have resulted in a 13-year extension to the Program from the original end date in 2024 to the current one in 2037. The impact on public participation is two-fold: 1) it challenges the Program's ability to hold the interest of the public, and 2) the project work is now spread out over an additional 13 years, which extends the disruption caused by construction and the need for patience from the public.

As a result, public outreach strategies and tactics have adapted too. The high-touch strategies from 2015 to 2019, which included in-person presentations, meetings with business organizations, and interaction with classrooms and events, were halted in early 2020 due to the pandemic. Even while engaging in high-touch activities, the public participation team had built a foundation of online resources and enhanced an already established website presence allowing public education and outreach to continue.

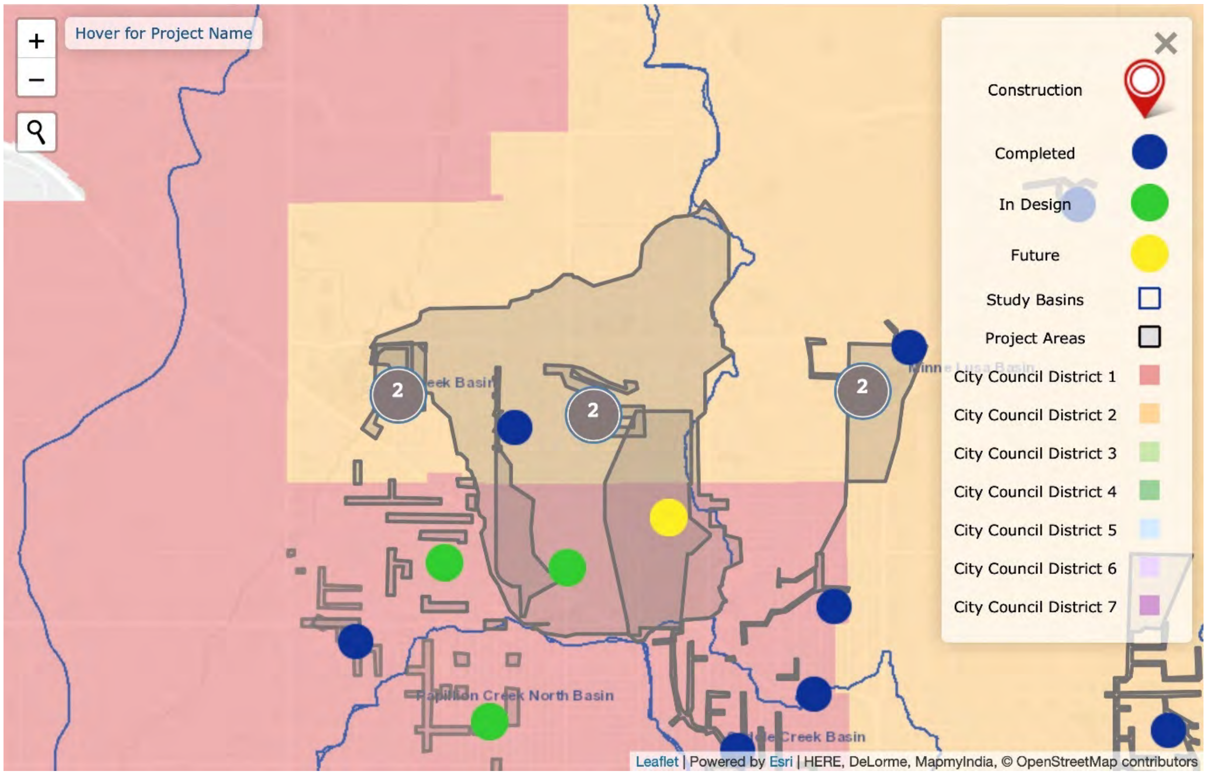

FIGURE 7-5
Interactive Project Map on OmahaCSO.com

The CSO Program public website, OmahaCSO.com, is an on-demand clearinghouse for pertinent Program- and project-related materials and resources. It has evolved into a powerful tool to connect ratepayers with the important work being accomplished and to demonstrate transparency and the thoughtful stewardship of ratepayer dollars. A few key features include the following:

- Project Information

  Comprehensive information regarding all projects, including those that are complete, those in the design and construction phase, and those slated for the future. An interactive, geographic information system (GIS) project map, Figure 7-6, helps users find project information by location using a zoom feature or by simply entering an address. Links take users to project pages that may feature time lapse video, photographs, maps, descriptions, schedule, contacts, and other resources.

- Contractors' Corner

  To support a transparent, competitive bidding environment, multiple resources are provided so contractors can easily view projects that are expected to bid over the next 12 to 18 months. Along with the schedule, scopes of work, early quantities, and detailed project overviews are provided. Promoting competitive bids can help reduce ratepayer costs and promote a diverse workforce. Figure 7-7 is an example of what can be found on the Contractors' Corner.

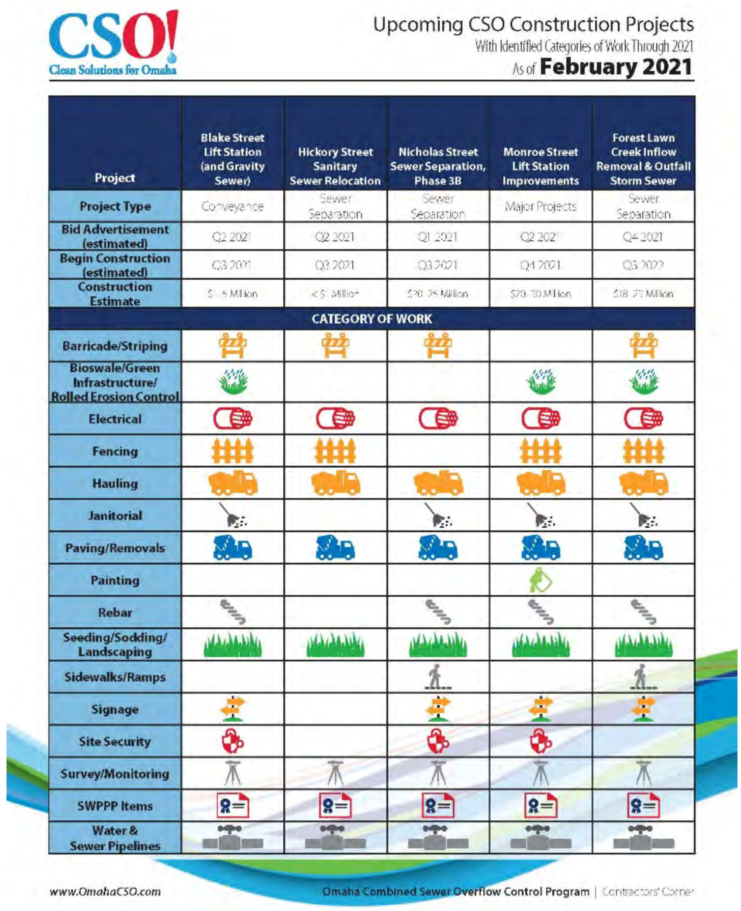

FIGURE 7-6
Contractors' Corner on the Website

- Reporting

  An essential component of complex, long-term infrastructure improvement programs is regular, detailed reporting and decision documentation of the work being performed. Technical reports are provided to elected officials and governing bodies on a monthly and quarterly basis and to regulators annually. A public-friendly newsletter update is provided quarterly to general subscribers. All documents are available on the CSO website for transparency.

- E-learning

  Youth outreach has been a CSO Program focus for many years. It has included guest lectures, project tours, demonstrations, and other activities for middle and high school students as well as post-secondary students. This outreach is used to spark interest in engineering and construction careers. The virtual tools developed during COVID-19 provide education related to waste and stormwater technology, and to highlight the City's efforts related to clean water, and encourage conservation and stewardship. Worksheets, videos, and an activity booklet are provided to supplement in-person education and support parents and teachers in the E-learning environment. Figure 7-8 is an example of the information available on the website.

FIGURE 7-7
E-learning on the Website

The Clean Solutions for Omaha brand was refreshed and an online resource center for templates, graphics, and materials was introduced. In addition, throughout the current LTCP period, materials were created and updated to inform those impacted by projects and to engage the community in understanding the benefits of this complex, long-term Program to reduce CSOs and discharge cleaner water to the Missouri River and area streams.

In the second quarter of 2020, Public Outreach responded quickly and effectively to the COVID-19 crisis by adapting its action plan to virtual engagement. Projects continued to progress on design and construction. To bridge public outreach needs, video presentations were created for sharing with the impacted stakeholders, making information available in online meeting formats that allow for direct participation or a “watch at your convenience” option. The Program has continued to reach out one-on-one, emailed quarterly updates, provided project updates on construction, and updated the website. And while neighborhoods suspended meetings, Program email updates were distributed through those peer networks. Since construction was able to continue, communications to the community about active projects also leveraged the virtual and online strategies. This included outreach to contractors and small businesses.

7.2.2 Future Efforts

Public participation plans for the known and adapts to the unknown. Before 2020, public outreach had many communications channels in place and had built strong, trusted relationships in the community. But 2020 presented new challenges as people stayed home, children became remote learners, and face-to-face communications halted due to the COVID-19 pandemic. Public outreach adapted by creating videos, using social media, strengthening the Program public website, reaching out by phone, staying in contact with neighborhoods, and providing all of the necessary information through online channels and email. Figure 7-9 shows a virtual public meeting.

FIGURE 7-8
Virtual Public Meeting

When a program has the duration of the CSO Program (28 years), it is critical to have procedures and protocols in place so that the hundreds of designers, engineers, architects, project managers, and contractors consistently implement the communications standards.

In 2020, the public participation facilitation team updated the Public Outreach Guidance, a document for planning and executing CSO Program communications. Active City, project and Program managers attended public participation workshops to understand the guidelines and how they can elevate the future work of the Program. Implementation will provide continuity and guide measured and effective public engagement.

Additionally, the timeline extension will impact the style of public involvement.

- Projects will be initiated over a longer period, which means residents who may not have been previously aware or involved with CSO projects will need information.
- Elected officials at the city, state, and federal levels are all subject to election cycles. It is inevitable that educating new office-holders will be necessary.
- As more people adapt to online information, finding new and energizing ways to meet people where they are means the Program will need to continually evaluate and adapt to leverage changing technology and digital devices.

As public participation has pivoted to virtual strategies, the Program has been able to engage a more diverse audience. People can access the information at their convenience and not be hindered by a dictated timeframe, and some people find it easier to speak out. It is a tactic that will be embraced along with returning to in-person open houses and neighborhood meetings when that is possible.

Another transition in the public outreach process will be continuing to build relationships with businesses and neighborhoods. The style of outreach will be more educational and informational, rather than including public decision-making due to the types of projects — for example, treatment facilities or storage tanks. Sewer separation projects will continue to be high-touch and require frequent engagement, as they have been in the past.

Expanding economic inclusion and diversity strategies is important to public engagement. When construction is going on in a neighborhood, residents want to see contractors who reflect the population of the neighborhood. The CSO Program's EEIT continues to build on its pillars of workforce opportunities, small and small emerging businesses, and youth. The website features current and upcoming bidding opportunities and there are multiple opportunities to provide for contractor outreach. Figure 7-10 shows photos from two events.

FIGURE 7-9
Two events that are part of CSO's Economic Equity and Inclusion Taskforce. Left: a youth STEAM event; Right: "Coffee with a Contractor"

Future public participation is multi-faceted and may include the following tactics:

- Virtual meetings, both live and on-demand
- Accessible and robust information on the Program public website
- Animated and live-action educational videos to explain various aspects of the Program (Figures 7-12 and 7-13)
- Video topics about economic inclusion, retention treatment basins (RTBs), and other topics by Program and project experts
- Online youth engagement and learning activities (Figure 7-11)
- Classroom presentations and demonstrations
- Engagement activities designed for secondary education students
- Project site tours
- Local- and national-earned media stories to highlight project successes (Figure 7-16)
- Educational blog posts
- Social media focused on Twitter
- User-friendly, interactive Program website
- Monthly Program Snapshot reports
- Quarterly Program Reports
- Annual Reports
- Elected officials' outreach by the Program and the City
- Presentations to civic, not-for-profit, and business organizations
- Continued interaction with neighbors, neighborhood associations, and alliances

FIGURE 7-10
Activity Guide, Available in both English and Spanish

FIGURE 7-11
Website Animation Video

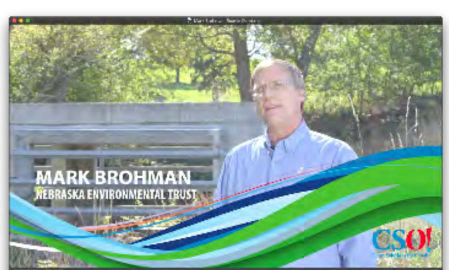

FIGURE 7-12
Website Interviews

- Engagement with educational institutions
- Contractor diversity and inclusion promotion
- Dedicated hotline for assistance and complaint resolution
- Quarterly Program public facing e-newsletters
- Project update emails

7.3 Public Involvement in the 2021 LTCP Update

7.3.1 Stakeholders

It is the responsibility of the Program to communicate the LTCP Update elements to the stakeholders and to accept their input. The plan reflects the results of an Optimization Evaluation conducted over the past 3 years and adaptations to the 2014 LTCP Update. The primary stakeholders are previously noted.

7.3.2 Public Participation Tactics to Communicate the LTCP Update

The public participation approach for communicating the LTCP Update continues to adapt due to pandemic effects and Centers for Disease Control and Prevention (CDC) guidelines that limit in-person interactions. Even when it may have been safe to be in public, the City has learned that stakeholders are just as comfortable, and in some instances more engaged, if they can access or interact in a virtual environment. The City prepared for both approaches during the timeframe for the City to educate and inform the public about the next phase of the Clean Solutions for Omaha Program as noted in the following tactics defined here:

- Public meeting(s) — both in person with CDC and City guidelines in place and with virtual interactive engagement tools. This includes working through neighborhood associations to provide information sessions with affected neighborhoods.
- Stakeholder meetings with elected officials and industrial ratepayers.
- Video presentations to reflect goals of capture, fulfilling the Consent order, highlighting major changes, and the path forward.
- Program public website feature on the home page with a video presentation and resource information.
- Blog posts leading up to the release that feature success stories of the Program.
- Blog post after the LTCP Update is introduced to explain highlights by experts.
- Increased social media postings to drive the stakeholders to website information (Figure 7-14).
- Media briefings for news coverage and interview opportunities.
- Utilizing Snapshots, quarterly reports, the e-newsletter, and other channels to provide information.

FIGURE 7-13
Social media posts on Twitter

7.3.3 LTCP Update Messaging

The public messages about the Program are positive and will reflect the rationale behind key changes, the Program efficiencies, and the successes leading into the next LTCP Update.

- Success with projects

  It is important for the public to have an understanding about how Program successes build on each other to meet the Clean Water Act (CWA) goals. The City will share examples that represent how sustainable solutions have been incorporated, for example:

  - Community enhancements like Fontenelle Lagoon, Spring Lake Park, Adams Park (Figure 7-15)
  - Local labor force, enhanced small business engagement

FIGURE 7-14
Spring Lake Park Before and After

- Effectiveness of completed projects to meet/exceed regulatory compliance.

  Provide information and data on how completed projects have reduced the bacteria in the Missouri River and Papillion Creek tributaries as well as reduced combined overflows.

- Implementation of cost effective solutions

  Continue to message the steps taken to reduce cost while maximizing the effectiveness of the controls being implemented. Such actions include green solutions (green infrastructure), grants, re-engineering efforts, and constructability cost containment strategies.

FIGURE 7-15
Cover story in Storm Water Solutions magazine

- Critical changes

  As the Program evolved processes, estimates and projects have been scrutinized to ensure the best Program implementation possible through optimization. The Program timeline has been extended to accommodate *force majeure* circumstances and provide the opportunity to reduce financing options. The CSO Program, within the adaptive management process, has maximized cost savings always mindful of meeting its 85 percent capture goal. The rate assistance program, which has already provided more than $12.3 million in relief, continues to assist low-income customers as rates rise. Transparency and multi-channel communications to the public about these key elements will continue to build public trust and community acceptance.

7.4 Summary and Conclusions

The City is committed to an active Public Participation Program. Over the timeframe of the Program, outreach efforts have expanded and evolved to meet the needs of the community. The multi-faceted approach to public outreach and the sophistication of its implementation have been recognized by professional organizations, acknowledged by third parties, and continues to be innovative.

Over the next 5 years, the strategies will embrace new technology, expand social media, build community relationships, and provide the information and outreach to be successful. On a monthly basis, the City tracks and reports the progress of engagement through both third-party sources and data gathering. The City will continue to work toward and advance the goal of community acceptance.

8 Post Construction Monitoring Plan

8.1 Introduction

The original Post Construction Monitoring Plan (PCMP) was developed for the City of Omaha (City) as a basic requirement of the 2009 Long Term Control Plan (LTCP) and attached to the 2009 LTCP as an Appendix. It was intended to comply with the requirements of the United States Environmental Protection Agency (EPA) combined sewer overflow (CSO) Control Policy regarding the submission of a Post Construction Monitoring Program. Specifically, the Policy states regarding the LTCP submittal (EPA, 1995a):

> "9. Post-Construction Compliance Monitoring Program
>
> The selected CSO controls should include a post-construction water quality monitoring program adequate to verify compliance with water quality standards and protection of designated uses as well as to ascertain the effectiveness of CSO controls. This water quality compliance monitoring program should include a plan to be approved by the NPDES authority that details the monitoring protocols to be followed, including the necessary effluent and ambient monitoring and, where appropriate, other monitoring protocols such as biological assessments, whole effluent toxicity testing, and sediment sampling."

The updated PCMP is included with this LTCP and can be found in Appendix A. It was developed to meet the above criteria. This section provides a summary of the plan.

8.2 Post Construction Monitoring Plan Objectives and Approach

The objective of the PCMP is to collect data to document and assess the extent to which the CSO controls included in the LTCP achieve performance criteria. The performance criterion established in the 2021 LTCP Update is to, at a minimum, capture 85 percent of wet weather volume in the representative year as defined in the LTCP.

To assist communities in development of their PCMPs, in May 2012, EPA published a guidance document titled *CSO Post Construction Compliance Monitoring Guidance*. It states that post-construction compliance monitoring requirements based on previous guidance are as follows:

> "The post construction compliance monitoring plan should be implemented during the implementation of the LTCP, and it should continue after the LTCP has been implemented.
>
> The plan should be designed to measure effectiveness of the overall LTCP and provide accountability. It should include a discussion of appropriate measures of success.
>
> The plan should account for variability of rainfall and CSOs and should focus on ensuring that the data specifically allow the evaluation of the effect of a particular control on the receiving water(s).
>
> The plan should include a map of the monitoring stations, monitoring schedules (including the frequency and duration of sampling at each station), a parameter list, a discussion of monitoring protocols, and a quality assurance project plan (QAPP).
>
> The ambient monitoring locations should be appropriate to determine the full range of CSO impacts on the waterbody(ies).
>
> To the extent possible, the plan should incorporate existing monitoring stations (both those used in previous studies and those used for collecting data during system characterization). This will allow the comparison of post construction data to pre-construction data to evaluate long-term trends.
>
> The plan should include two types of data collection:
>
> - Data collection to measure the overall effects of the program on water quality.
> - Data collection to determine the effectiveness of CSO controls.
>
> The types of pollutants and parameters to be analyzed should be based on pollutants key to the attainment of designated use(s) of the receiving water, and pollutants affected by the CSO controls, and might include chemical, physical, or biological parameters.
>
> The monitoring should be coordinated with any ongoing or planned state monitoring programs, programs of other permittees within the same watershed, or both."

This plan has been developed with these goals in mind. In addition, implementation of the PCMP will allow the City to:

- Measure the effectiveness of infiltration and inflow (I/I) reduction efforts
- Measure the performance of the CSO controls (such as the retention treatment basins [RTBs]) to determine if they are achieving their specific performance criteria in treating wet weather flows
- Measure the effectiveness of the control measures, such as sewer separation

- Update and enhance collection system hydraulic computer models
- Identify and evaluate improvements in receiving water quality that may result from the implementation of the measures

This PCMP describes two major approaches. One approach is the Water Quality Monitoring Plan, which obtains water quality data of the receiving streams with the intent to measure any changes over time that may result from the implementation of the CSO controls. This is described in Section 3 of the PCMP.

The second approach is monitoring the effectiveness of the controls. This approach is included in Section 4 of the PCMP. This includes both short-term flow monitoring of duration before and after project completion including both sewer separation and major pumping station improvements, wet weather storage tanks and conveyance sewers, and upgrades of existing water resource recovery facilities (WRRFs).

This plan does not address requirements, if any, that may be imposed in CSO permits subsequent to the City showing achievement of the 85 percent wet weather volume capture, with the exception that some level of monitoring of the frequency, magnitude, and duration of remaining CSOs will need to be reported. It is anticipated that any requirements will be negotiated as part of a future permit closer to the end of the LTCP.

8.3 Modification to the Post Construction Monitoring Plan

The PCMP in Appendix A is a significant update to the City's plan included in the 2009 LTCP. Most notable is a focus on the achievement of 85 percent wet weather volume capture. This has resulted in the addition of a new section titled, "Effectiveness of Controls." In addition, the section on Water Quality Instream Sampling has been updated to reflect the sampling that is currently being done by the United States Geological Survey (USGS) on the Missouri River.

8.4 Water Quality Monitoring Plan

The PCMP addresses both CSO outfall monitoring and instream water quality monitoring. Information on sampling and analytical procedures as well as details on the sampling procedures, analysis, and data assessment are included in Attachment 1 to the PCMP.

The CSO outfall water quality monitoring described in the monitoring plan refers to the monitoring of CSO discharges where a CSO control has been established. Table 8-1 summarizes the locations currently being monitored. The parameters listed for CSO 102 and CSO 205 are already established in the City's CSO Permit and are reported in discharge monitoring reports and summarized in the Annual Reports.

TABLE 8-1
CSO Control Water Quality Monitoring Locations Under the Post Construction Monitoring Program

Monitoring Station Identification	CSO Point	Description	Receiving Water	Water Quality Monitoring
CSO 102 Disinfection	CSO 102	Discharge from Chlorine Contact Basin	Missouri River	BOD TSS pH TRC Total Flow *E. coli* Duration of Discharge Number of Sampling Events
CSO 205 Saddle Creek RTB (SCRTB)	CSO 205	Discharge from RTB	Little Papillion Creek	BOD TSS pH TRC Total Flow *E. coli* Duration of Discharge Number of Sampling Events
Northeast Omaha RTB – 6th and Abbott	CSOs 105,106, 107, and 108	Discharge from RTB	Missouri River	BOD TSS pH TRC Total Flow *E. coli* Duration of Discharge Number of Sampling Events

BOD = biochemical oxygen demand

TRC = total residual chlorine

TSS = total suspended solids

In addition to the CSO outfall monitoring, instream water quality monitoring is being performed. Since 2012, the USGS Nebraska Water Science Center has been conducting a Missouri River water quality monitoring program at selected points in the Missouri River. Figure 8-1 shows USGS performing water quality analysis. The following are the goals of the monitoring program:

- Provide continuous stage and discharge records for the Missouri River at locations important to the pursuit of understanding the water quality in the river.

FIGURE 8-1
USGS Performing Water Quality Analysis

- Provide continuous monitoring of selected water quality parameters at such locations.
- Provide monthly discrete water quality sampling of selected compounds at such locations.

In addition to the USGS sampling, the City performs sampling of the Papillion Creek tributaries at various points. The data are provided in the CSO Annual Reports provided to Nebraska Department of Environment and Energy (NDEE) to summarize the CSO Program for each year.

Table 8-2 lists the monitoring locations for both the USGS and City Sampling. Figure 8-2 shows these locations.

TABLE 8-2
Discrete Stream Monitoring Locations

Monitoring Station Identification	Stream	Location Description	Responsible Organization
MR-5	Missouri River	At NP Dodge Park (Above the City)	USGS
MR-4	Missouri River	Freedom Park (Below the Airport)[a]	USGS
MR-CB	Missouri River	Council Bluffs (5 miles downstream MRWRRF and above the confluence with Papillion Creek, north/east side of the river)	USGS
MR-1	Missouri River	La Platte (downstream of the PCWRRF and below the confluence with Papillion Creek but above the Platte River)	USGS
PC-1	Papillion Creek	Downstream of the confluence with Big and West Papillion Creeks	City
BPC-4	Big Papillion Creek	Upstream of the confluence with Little Papillion Creek	City
BPC-3	Big Papillion Creek	Downstream of the confluence with Little Papillion Creek	City
LPC-3	Little Papillion Creek	Upstream of the confluence with Cole Creek	City
LPC-1	Little Papillion Creek	Downstream of CSO discharges and upstream of confluence with Big Papillion Creek	City
CC-2	Cole Creek	Upstream of CSO discharge points	City
CC-1	Cole Creek	Downstream of CSO discharge points	City

[a] This site has also been sampled by the NDEE.

MRWRRF = Missouri River Water Resource Recovery Facility

PCWRRF = Papillion Creek Water Resource Recovery Facility

The parameters that are to be monitored for each location and whether field or lab analysis will be performed are listed in Table 8-3. The results of this analysis are included in the Annual Report each year.

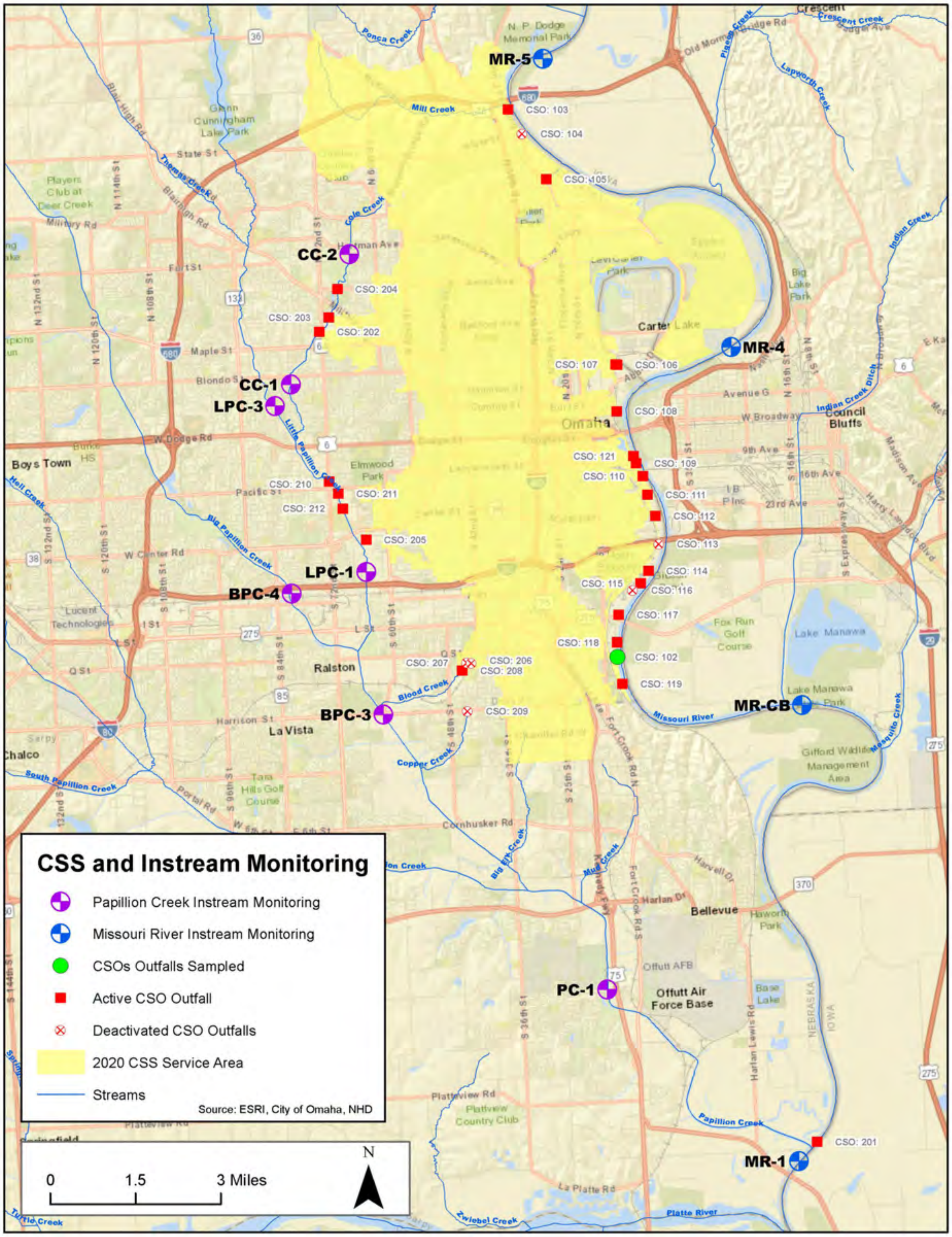

FIGURE 8-2
Monitoring Locations

TABLE 8-3
Parameters of Concern for Discrete Sampling

Parameters	Monitoring Locations
Field Measurements	
pH	City and USGS Instream Monitoring Locations
Specific Conductivity (µMHO/cm)	City and USGS Instream Monitoring Locations
Temperature, ºC	City and USGS Instream Monitoring Locations
Dissolved Oxygen (mg/L)	City and USGS Instream Monitoring Locations
Presence of Solids or Foam	City and USGS Instream Monitoring Locations
Discharge (cfs)	USGS Instream monitoring locations
Number of days since last precipitation (days)	USGS Instream monitoring locations
Laboratory Analyses	
TSS (mg/L)	City and USGS Instream Monitoring Locations
Turbidity (mg/L)	USGS Instream Monitoring Locations
BOD (mg/L)	City and USGS Instream Monitoring Locations
Total Orthophosphate	USGS Instream Monitoring Locations
Chloride	USGS Instream Monitoring Locations
E. coli, (cfu/100 mL)	City and USGS Instream Monitoring Locations
Total Coliform (MPN/100 mL)	City and USGS Instream Monitoring Locations
Total Phosphorus	USGS Instream Monitoring Locations
Total Kjeldahl Nitrogen (TKN)	USGS Instream Monitoring Locations
Total Nitrogen	USGS Instream Monitoring Locations
Nitrate + Nitrite	USGS Instream Monitoring Locations
Ammonia Nitrogen	USGS Instream Monitoring Locations

ºC = degree(s) Celsius

µMHO/cm = micromhos per centimeter

cfs = cubic feet per second

cfu/100 mL = coliform units per 100 milliliters

mg/L = milligram(s) per liter

MPN/100 mL = most probable number per 100 milliliters

8.5 Effectiveness of Controls

The performance criterion for CSO controls is 85 percent wet weather volume capture of combined sewage flows. Achievement of the 85 percent wet weather volume capture will be through three avenues: sewer separation (eliminating stormwater from the combined sewer system [CSS] to reduce/prevent CSOs), treating CSO, and detention of wet weather flows for subsequent treatment. As part of the implementation of the CSO controls, the following is assumed:

- Permanent flow monitoring devices will be installed within the system at locations that will assist with understanding the overall operation of the system and be of value in the calibration of the final CSS hydraulic model.
- Permanent flow monitoring will be in place for all CSO points that will remain open following completion of the LTCP. This will provide the ability to measure level and velocity and thus calculate the frequency, magnitude, and duration of CSOs either directly or indirectly. It is anticipated that this information will need to be reported as part of future permits.
- Sewer separation will result in the elimination of some stormwater flows from the CSS and may result in the permanent closure of select CSO outfall locations.
- Treatment of CSOs will be accomplished with RTBs and the Chlorine Contact Basin. When measuring the effectiveness of controls at a specific RTB or the Chlorine Contact Basin, the monitoring plan developed by the design project team will be used. These monitoring plans will determine how and where to measure the overflow and how much is captured.
- Collection and detention of water will be accomplished through tanks and large-scale green infrastructure (such as Fontenelle Pond).

Measurement of the effectiveness of controls to meet the performance criteria is done with both individual controls and the overall measure of the effectiveness.

8.5.1 Flow Monitoring

An important part of the PCMP is to obtain data on the overall effectiveness of the controls. This requires the City to perform significant flow monitoring of the system. The City has been performing flow monitoring of its system since 2003 as part of the development of the InfoWorks Model. This is described in Section 2 of this LTCP Update. Figure 8-3 provides locations of permanent and 2020 temporary flow monitoring and rain gauges as an example.

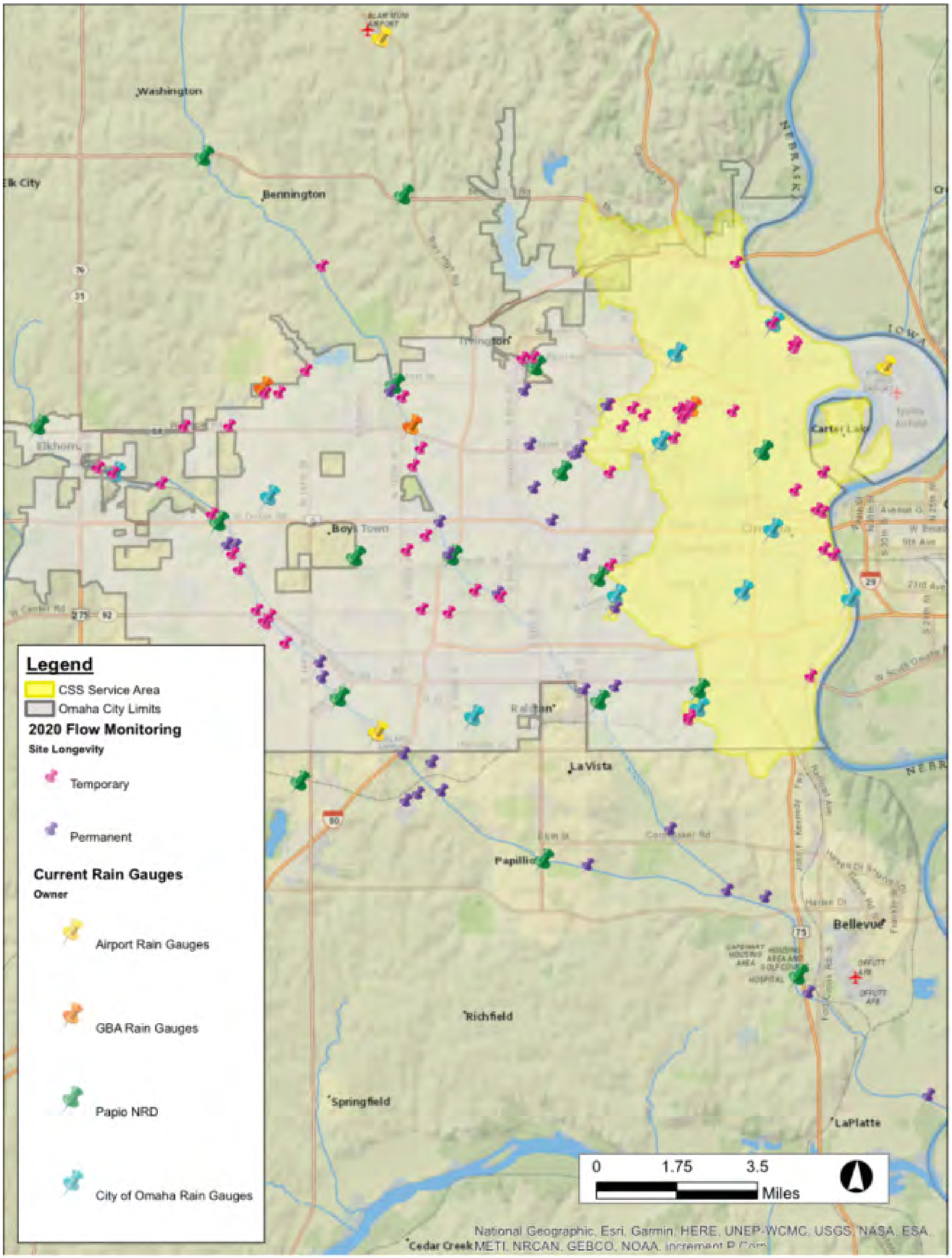

FIGURE 8-3
Permanent and 2020 Temporary Flow and Rain Monitoring Locations

8.5.2 Overall Effectiveness of Controls.

The CSO Permit fact sheet states in Part I.9 Statement of LTCP Compliance Objective (Part VII of the Permit):

> "The determination of no less than 85% capture by volume shall be based upon the volume of combined sewer overflows that occurred in the modeled representative year compared to the volume of combined sewage captured or eliminated after all controls and separation projects have been completed. To determine compliance with the Presumption Approach, the City of Omaha shall calibrate the combined sewer system model against actual flow information within 2 years after completion of the LTCP. The calibrated model results shall be compared with the combined sewers overflow from the selected design storm year. To be in compliance, the model must show that no less than 85% of the combined sewage in the combined sewer system has been captured or eliminated on an annual average basis when compared to the design year 1969."

The PCMP provides a summary of the approach that the City anticipates using to assess compliance with this overall performance criteria. Since completion of the CSO Program is not anticipated until 2037, it is anticipated that the approach will be modified as the result of future changes in the system and the development of technologies that are not in existence today. A final PCMP will be provided 2 years before completion of the Program, or in 2035. It is anticipated that this plan will also address any ongoing requirements that may be imposed in CSO permits after the City shows achievement of the 85 percent wet weather volume capture.

8.5.3 Effectiveness of Individual Controls

Monitoring will be conducted to assess how effective the individual controls are as CSO controls. This section discusses monitoring for sewer separation projects and monitoring for wet weather facility projects.

Monitoring sewer separation projects accomplishes the following two goals:

- Confirming that enough inflow has been removed from the system draining to the CSO discharge point that it can be closed or modified and ultimately deactivated and removed from the CSO Permit
- Measuring the effectiveness of the separation, which may be judged in a number of quantitative or qualitative ways, including but not limited to inflow reduction, CSO frequency reduction, and change in the size of storm event that triggers a CSO

Flow metering will be performed for sewer separation to evaluate flow reduction effectiveness. A period of monitoring before and after constructing the project will be conducted. Specific details for the City's flow monitoring program for sewer separation projects are as follows:

1. Prior to sewer separation projects, monitoring of CSO diversions and/or other locations within the sewer system will be conducted to measure combined sewer flows. In some cases, the City may decide an interior system point is a better location than the CSO diversion or outfall.

2. Following completion of a sewer separation project, flow monitoring will again be performed for use in modeling the post-construction sewer system condition. Monitoring sites may be immediately downstream of a project area, at a location designed to evaluate the improvements for several projects, at the CSO diversion, and/or in other locations, since the sewer system and project configurations vary. This could also include monitoring of the CSO outfall.
3. Based on an evaluation of the results of the flow monitoring and modeling, the City may determine that the project has achieved its objectives, that additional inflow reduction is needed in the area, that diversion modification is needed, or that future projects will be modified or proposed to enhance overall system performance.

For wet weather facility projects, individual monitoring plans for each facility will be developed. The purpose of these plans is to demonstrate achievement of their respective design criteria. In addition, it is likely that ongoing data will be collected for these facilities and used in the modeling needed to show compliance with the overall performance criteria.

Facilities for which individual monitoring plans will be developed include the following:

- SCRTB
- MRWRRF CSO 102 Chlorine Contact Basin
- Northeast Omaha RTB
- Leavenworth Basin Storage Tank Facility

Flow monitoring data may be reviewed from the following lift stations to verify that they are able to achieve their design flow rates:

- Leavenworth Lift Station
- Riverview Lift Station
- Burt-Izard Lift Station
- Monroe Street Lift Station
- South Omaha Industrial Area (SOIA) Lift Station
- In-Plant Lift Station

It is noted for the RTBs and CSO 102 that water quality monitoring of the discharge from the facility is also required as discussed in Section 2 of this PCMP.

8.6 Summary and Conclusions

The City has developed a PCMP that will measure compliance with the requirement to show that CSO controls achieve 85 percent wet weather volume capture on an annual average basis at the end of the Program and to show trends in water quality that could be related to the CSOs and implementation of the LTCP. This will be done with collection of water quality data on the Missouri River by the USGS and the Papillion Creek Basin by the City along with flow monitoring. In general, flow monitoring of the effectiveness of sewer separation will be performed by the City. Individual monitoring plans will be developed by project teams for wet weather facilities. Using the data validation methods in the attached plan, the City will be able to confirm achievement of this goal and sufficiently demonstrate it to EPA and NDEE.

As noted in the 2009 LTCP, the City will continue to use an adaptive management approach to implement the LTCP. Similarly, this PCMP will need to adapt its approach, and when needed, make modifications to the implementation of the plan, review of the data generated by the plan on a frequent basis, and modifications to the plan as needed based on the data gathered.

In addition, it is anticipated that the PCMP itself will need to be frequently reviewed and modified to ensure that it is collecting data useful for determining the status of the CSO controls effectiveness and achievement of water quality controls. Reasons for changing the monitoring plan may include the following:

- Changes in monitoring technologies.
- Addition or deletion of monitoring sites.
- Addition, modification, or deletion of parameters sampled or analyzed. Subsequent LTCP updates will review this plan and update as needed.

9 Wet Weather Operations Plan

9.1 Purpose

This Wet Weather Operations Plan (WWOP) was developed for the City of Omaha (City) as a basic requirement of the 2009 Long Term Control Plan (LTCP) and was intended to provide an overview of the collective operation of the combined sewer overflow (CSO) controls proposed by the City. The purpose of the WWOP is to meet the requirements in United States Environmental Protection Agency (EPA) CSO Control Policy, which states (EPA, 1995a):

> “6. Operational Plan
>
> After agreement between the permittee and NPDES authority on the necessary CSO controls to be implemented under the long-term CSO control plan, the permittee should revise the operation and maintenance program developed as part of the nine minimum controls to include the agreed-upon long-term CSO controls. The revised operation and maintenance program should maximize the removal of pollutants during and after each precipitation event using all available facilities within the collection and treatment system. For any flows in excess of the criteria specified at II.C.4.a.i., ii. or iii and not receiving the treatment specified in II.C.4.a, the permittee plan should ensure that such flows receive treatment to the maximum extent possible.”[1]

The City’s CSO Permit requires (NDEQ, 2015),

> “F. Operational Plan
>
> The City of Omaha submitted a preliminary WWOP that provides an overview of the collective operation of the combined sewer overflow controls to be

[1] The citations “at II.C.4.a.i., ii. or iii“ and “II.C.4.a” refer to portions of the EPA CSO Control Policy, specifically the requirements under the Presumption Approach.

implemented by the City in Section 8 Monitoring Program and CSO Wet Weather Operations Plan of the LTCP.

The City of Omaha shall update the WWOP as CSO projects are constructed and are operationally complete. Significant updates to the WWOP shall be included in the Annual Report."

The original WWOP was submitted with the 2009 LTCP. This document updates this plan to reflect the changes in the CSO controls as proposed in this LTCP. The WWOP in Appendix B presents the general overview of the control facilities, and how the City anticipates the control facilities' operation will be coordinated. It also provides general procedures, operation and staffing guidelines for the combined sewer system (CSS) during wet weather events based on the constructed controls, proposed controls in the LTCP, and general assumptions. It is anticipated that the procedures and staffing will be refined throughout the design of the individual facilities and during implementation of the Program.

9.2 Assumptions

The following assumptions were made in developing this WWOP.

9.2.1 Preliminary Document

The operational strategy of several control facilities that have been constructed and are in operation (for example, Missouri River Water Resource Recovery Facility [MRWRRF] Improvements) should be considered final. Operational strategies for control facilities that are currently under construction (for example, Saddle Creek Retention Treatment Basin [SCRTB]) have been developed but may change after the facility is in operation. The remaining control facilities proposed in the LTCP (for example, the Northeast Omaha RTB and Leavenworth Basin Storage Tank) are in the development phase and the operational strategy presented in this WWOP should be considered preliminary. As design of the Northeast Omaha RTB and the Leavenworth Basin Storage Tank facilities progress, this WWOP will be updated to include additional operations information for each of the facilities. In addition, detailed operations and maintenance (O&M) procedures will be developed as part of the design and construction of the controls, and operator training will be implemented during startup of the facilities. These detailed operational procedures are not included in this plan.

9.2.2 Operational Goals

The overall systemwide operational goals are in accordance with the EPA CSO Control Policy. The first priority for containing wet weather flows within the CSS is to convey as much of the flow as possible to the existing water resource recovery facilities (WRRFs) to maximize the amount of wet weather flow that will receive secondary treatment. For the MRWRRF, flows that do not receive secondary treatment will be discharged after primary clarification and will be disinfected prior to discharge. In addition to maximizing the capacity at the WRRFs, control measures for storage and high-rate treatment of the combined sewage will be implemented to limit the volume of untreated overflows to the receiving streams as indicated in the proposed LTCP. Operations of the WRRFs are discussed in greater detail in the WWOP.

9.2.3 Treatment Goals

The high-rate treatment systems will be designed to discharge an end-of-pipe *E. coli* concentration of 126 coliform units per 100 milliliters (cfu/100 mL) based on the geometric mean of all samples taken in a single day. High-rate treatment systems include the SCRTB, Northeast Omaha RTB, and the primary clarifiers and disinfection system at the MRWRRF. Compliance at end-of-pipe will be determined using geometric mean of all samples taken in a month; however, because months with only one wet weather event will occur, the limit is treated as a monthly geometric mean and ranges from 1,096 cfu/100 mL to 126 cfu/100 mL depending on the duration of the storm, as shown in the National Pollutant Discharge Elimination System (NPDES) Permit for CSO 102. The treatment systems will also provide some removal of biochemical oxygen demand (BOD) and total suspended solids (TSS) prior to discharge to the receiving streams, and at times, the controls will entirely capture the flow from smaller wet weather events.

9.3 Operation of Control Facilities

As part of the WWOP, the general operational approaches for each of the specific control facilities are presented in the following paragraphs and include inter-event, during-event, and post-event procedures.

9.3.1 General Operational Procedures

Several operational procedures are common to all controls within the system and are described below for inter-event, during-event, and post-event conditions. Operational procedures specific to each type of control facility are described under subsequent paragraphs dedicated to the operation of those controls.

9.3.1.1 Inter-Event

During the inter-event stage of operation, all flow from the Missouri River Watershed (MRW) CSS will be conveyed to the MRWRRF for secondary treatment. The use of the CSO control facilities will not be necessary for dry-weather flows. The dry-weather operations are shown schematically on Figure 9-1. Likewise, during the inter-event stage of operation, all flow from the Papillion Creek Watershed (PCW) will be conveyed to the Papillion Creek Water Resource Recovery Facility (PCWRRF) for secondary treatment. This dry-weather operation is shown schematically on Figure 9-2.

Maintenance. Proper maintenance of the CSS and WRRF is critical to ensure that the equipment is ready to function during wet weather events. Periodic preventive maintenance will be performed for mechanical equipment, including pumps, motors, screens, grit-removal equipment, control equipment, gates, and valves to keep all equipment in operating condition. In addition, corrective maintenance will be performed as soon as possible whenever a piece of equipment breaks down. Delays in maintenance could adversely affect the City’s ability to properly convey and treat the combined sewage in the system.

Weather Forecasting. Operators will monitor the weather systems in the area and the collection system and make final preparations to the facilities when a wet weather event is anticipated.

Operational Preparation. Additional screening, grit removal, primary clarification, and lift station pumping equipment will be needed during wet weather events beyond those required during dry weather. Mechanical equipment related to wet weather performance will be tested for proper operation prior to events. Backup facilities will be placed in standby mode to ensure quick response if an online piece of equipment fails during the event.

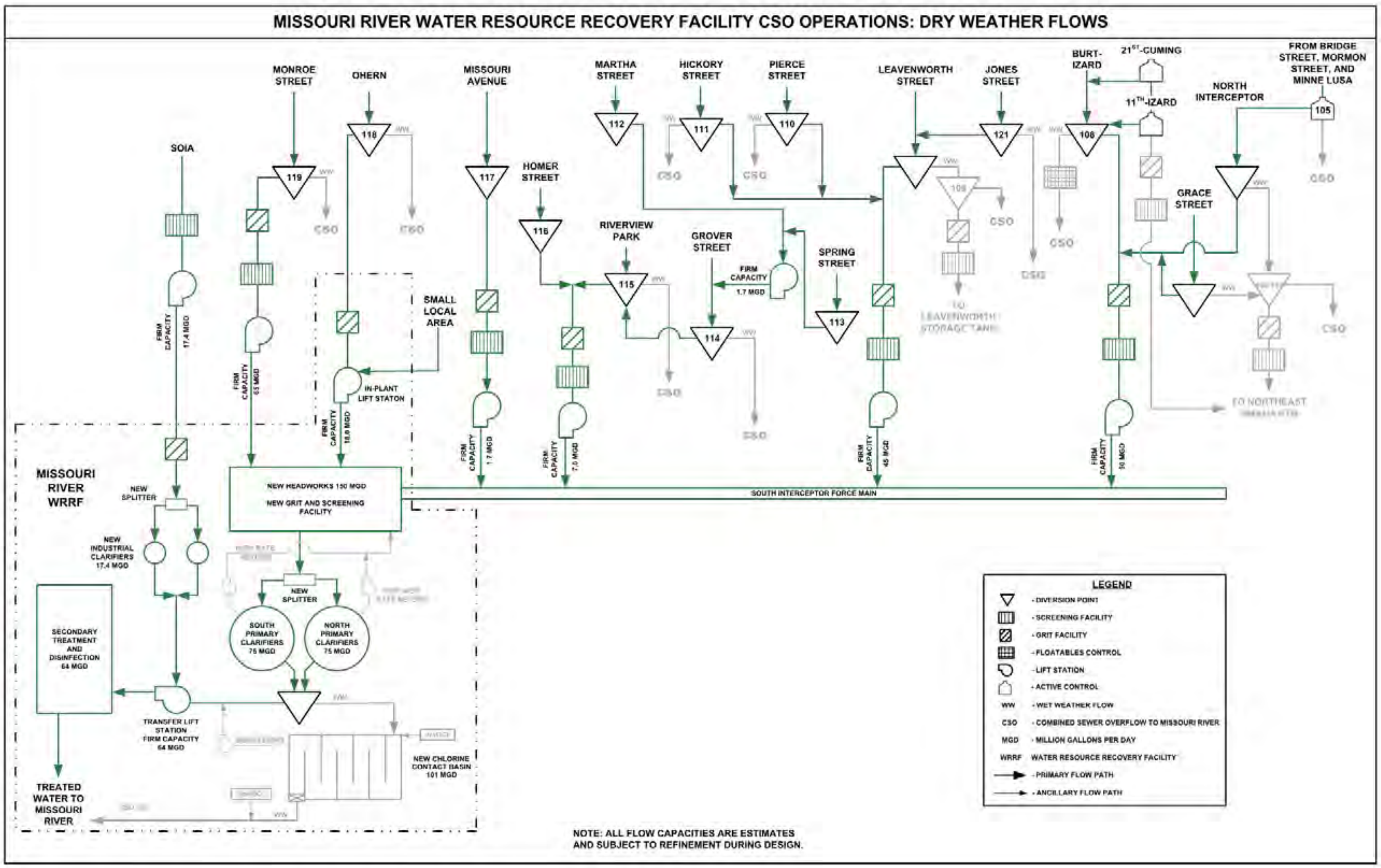

FIGURE 9-1
Missouri River Watershed System Operations Schematic – Dry-Weather Flow

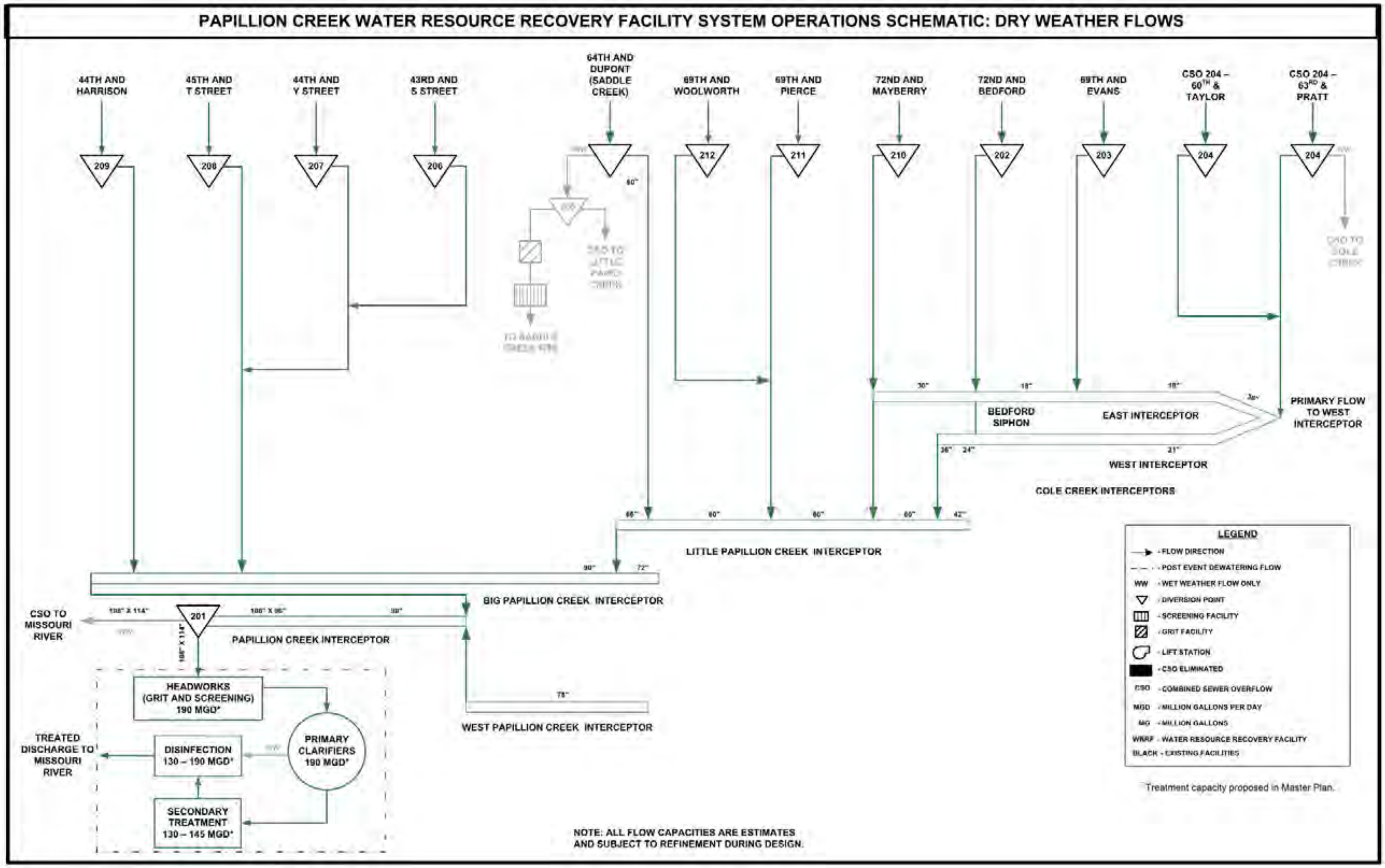

FIGURE 9-2
Papillion Creek Watershed System Operations Schematic – Dry-Weather Flow

9.3.1.2 During-Event

The following procedures will be followed to ensure facilities are able to convey and treat the wet weather flows during the event as effectively as possible. Figures 9-3 and 9-4 show the wet weather operation schematically:

Flow Monitoring. Flows within the system will be monitored to determine when wet weather facilities will be activated, and to provide for calculation of combined sewage volume capture.

Equipment Monitoring. The lift stations, WRRFs, storage tank, high-rate treatment, and other facilities will be monitored during the event to ensure proper operation of the screening, grit removal, pumping, primary treatment, secondary treatment, and chemical feed facilities. If equipment fails during operation, backup equipment will be brought online to maintain performance.

Sample Analysis. Process and compliance samples will be collected as appropriate, and laboratory analysis will be performed to monitor effluent discharge parameters to demonstrate compliance with permit limits.

CSO Monitoring. The CSO discharge points will be monitored for overflows and samples will be collected as appropriate for system analysis and compliance.

Odor Observation. The conveyance and treatment systems will be periodically observed for odor issues during and after events. It is unlikely that odor-control systems will be necessary at all times within the conveyance system; however, this will be confirmed as the systems operate to prevent nuisance odors in the community.

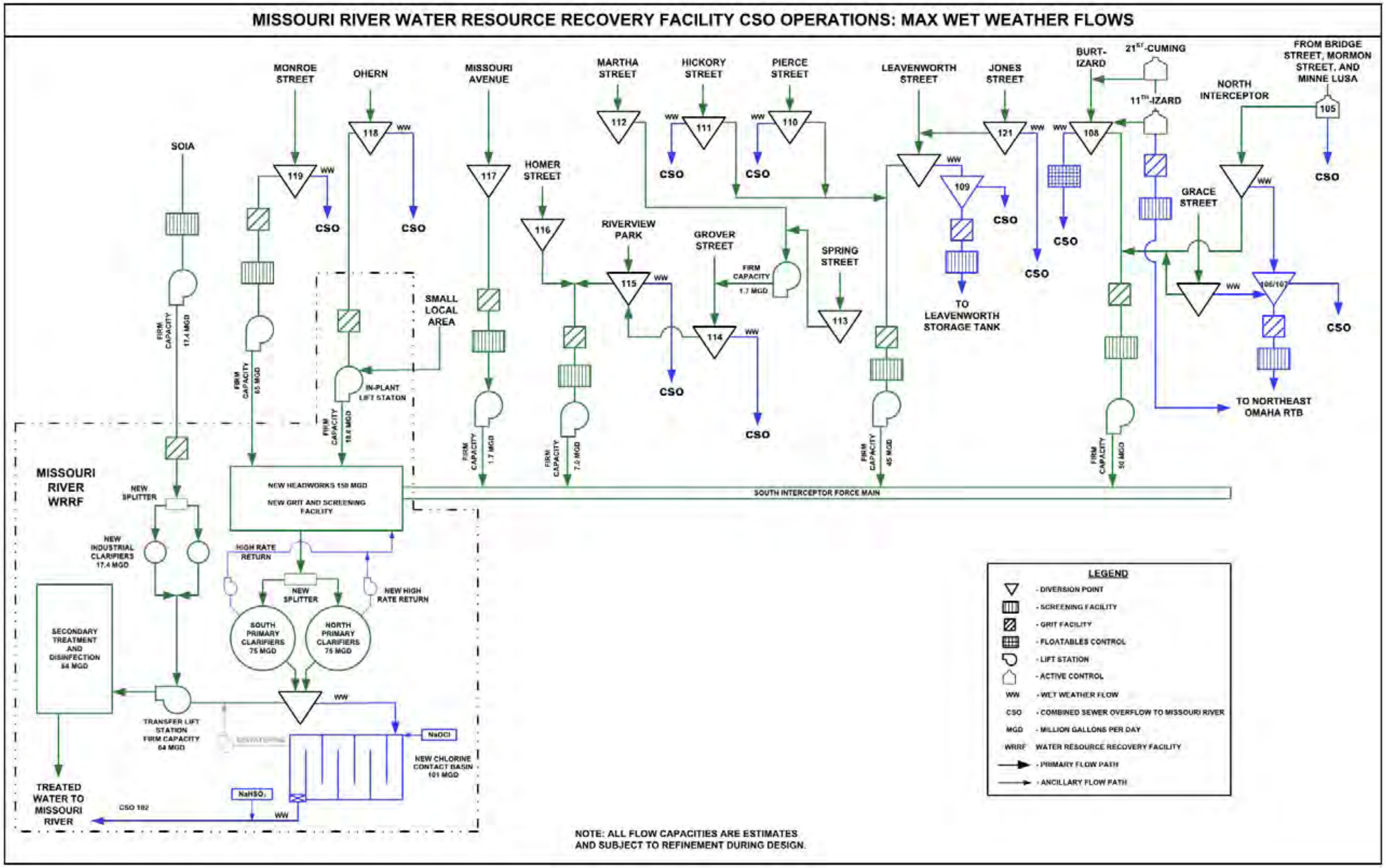

FIGURE 9-3
Missouri River Watershed System Operations Schematic – Maximum Wet Weather Flow

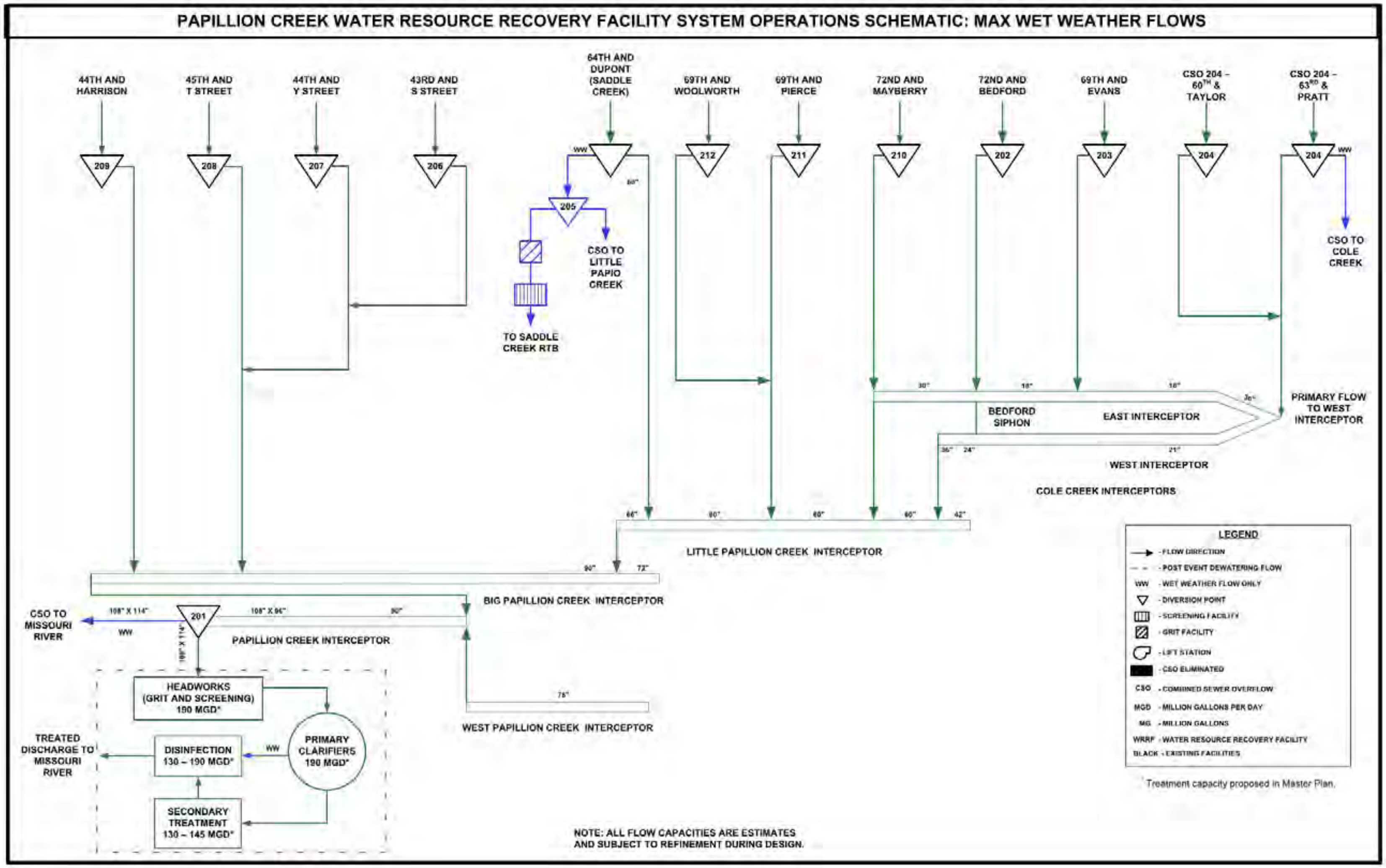

FIGURE 9-4
Papillion Creek Watershed System Operations Schematic – Maximum Wet Weather Flow

9.3.1.3 Post-Event

After monitoring of the collection system has indicated that the effects of the wet weather event on the CSS have subsided and depending on the size of the wet weather event, the following general procedures will be followed. Figures 9-5 and 9-6 show the post-event operation schematically:

Dewatering. Dewatering of the storage tanks, RTBs, headworks channels, primary clarifiers, and chlorine contact basin will be required in most cases. Facilities will be dewatered when capacity in the secondary treatment system exists. Dewatering of the individual facilities will be coordinated to ensure capacity of the secondary treatment system is not exceeded from multiple dewatering operations. Flushing may be required to remove accumulated solids from the bottom of the channels and basins.

Cleaning. Cleaning operations will include grit removal and disposal at the grit collection areas within the system, including grit pits, lift stations, and WRRF headworks; and removal and disposal of screening material at the WRRF headworks, the Leavenworth Basin Storage Tank, SCRTB, Northeast Omaha RTB, and lift stations.

Facility Inspection. After facilities are dewatered, the facilities will be inspected so they are prepared for the next wet weather event. Inspection will include the evaluation of equipment to determine if repairs are necessary for proper operation.

Event Reporting. Wet weather event reports will be completed after post-event activities have been completed for each event. Data not available during the event will be gathered, such as laboratory analyses, and incorporated into the report as required. Reports will be transmitted to the appropriate City staff for transmittal to governing authorities as required.

Chemical Inventory. An inventory of the remaining chemical will be conducted and orders placed as needed for disinfection, dechlorination, and odor-control chemicals if appropriate.

Section 1.4 of the WWOP provides specific operational plans for the wet weather facilities. These include MRWRRF, SCRTB, Northeast Omaha RTB, and Leavenworth Basin Storage Tank, as well as the various active controls.

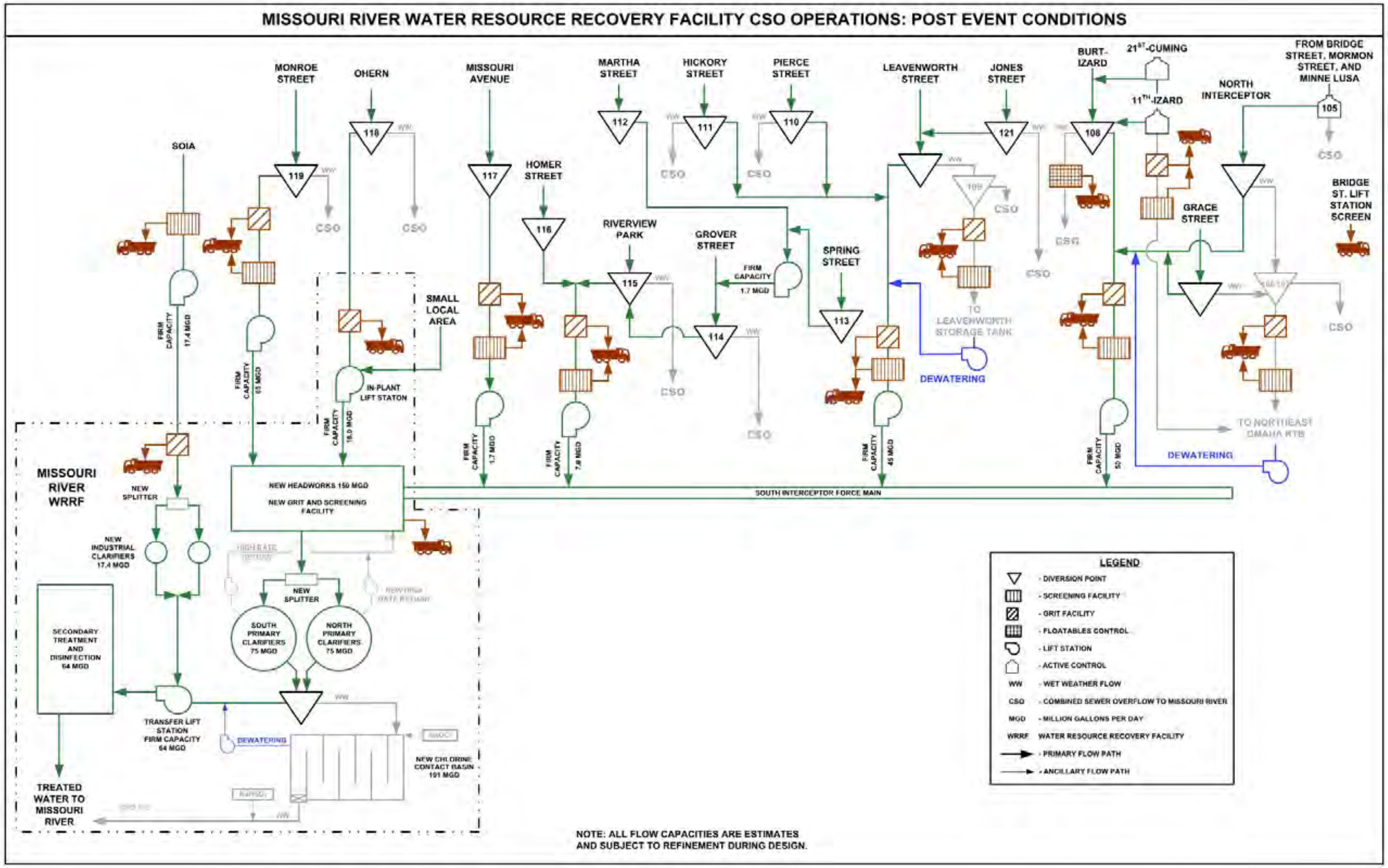

FIGURE 9-5
Missouri River Watershed System Operations Schematic – Post-Event Conditions

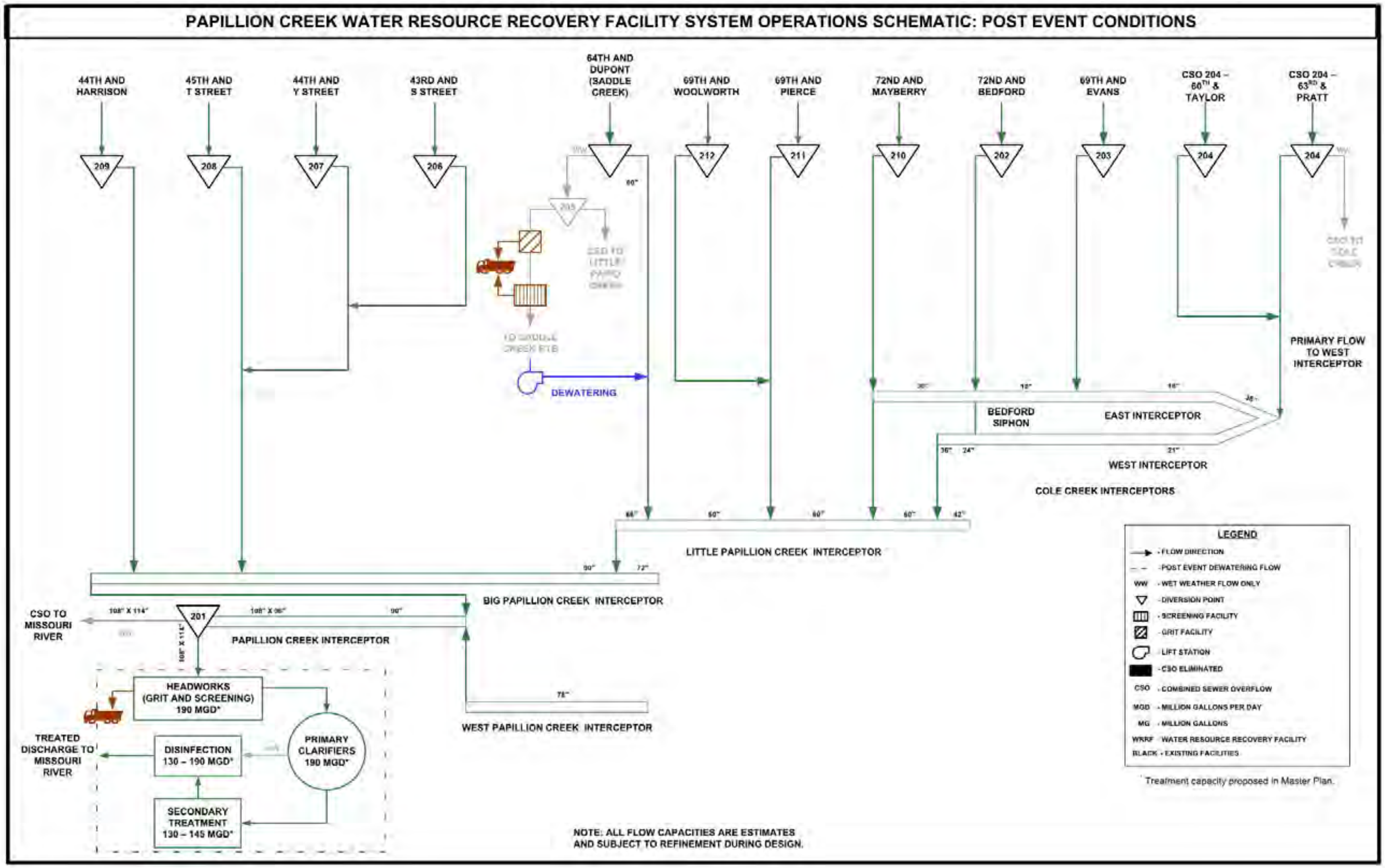

FIGURE 9-6
Papillion Creek Watershed System Operations Schematic – Post-Event Conditions

9.4 Collection System Lift Stations

The collection system lift stations will follow the same general maintenance procedures, although some differences may occur between specific facilities. The lift stations include the Bridge Street Lift Station, Burt-Izard Lift Station, Leavenworth Lift Station, Blake Street Lift Station, Riverview Lift Station, Missouri Avenue Lift Station, In-Plant Lift Station, the South Omaha Industrial Area (SOIA) Lift Station, and Monroe Street Lift Station, as listed in Table 9-1.

TABLE 9-1
Proposed Lift Station Capacities

Name	Firm Capacity (MGD)
Bridge Street	0.9
Burt-Izard	50.0
Leavenworth	45.0
Blake Street	1.15
Riverview	7.0
Missouri Avenue	1.7
In-Plant	18.0
SOIA	17.4
Monroe Street	65.0

MGD = million gallon(s) per day

9.5 Sampling and Operational Goals

An important part of the operations of the CSO control structures is to ensure their performance and to comply with any regulatory requirements. This will be done through performing both NPDES-related sampling and process sampling. During the design of these structures, the necessary systems will be incorporated to collect the needed information. Monitoring of these structures is also discussed in the Post Construction Monitoring Plan (Appendix A).

9.6 Staffing

Once the facilities and projects under the LTCP have been constructed, the structures will need to be operated and maintained to ensure that they perform as required. Having adequate staff is as important to meeting the goals of the LTCP as having the structures designed and constructed properly.

There are several groups within the City that will have a role in the operation and maintenance of the treatment and sewer systems once the LTCP is fully implemented. The existing staff in these operational groups will be supplemented with additional staff to handle additional activities anticipated under the LTCP. The operation divisions and the additional activities resulting from the LTCP are summarized in the WWOP (Appendix B).

9.7 Potential Future System Modifications Through Real-Time Controls

Throughout the implementation of the LTCP the City will continue to evaluate methods to maximize use of the existing collection system. This involves evaluating the implementation of real-time controls (RTC) and active controls to maximize flow to both the WRRFs. Implementation of RTC will likely result in changes to operations.

In addition to maximizing the use of the collection system, over the next 5 years, the City will be evaluating the possible use of RTC to take better advantage of the existing stormwater controls. Examples of possible locations include the Fontenelle Park Lagoon, Adams Park, and the 20th & Poppleton Stormwater Storage facility. The City will also continue to evaluate areas where green infrastructure will have a maximum benefit to the system and the community. Specific maintenance plans for these facilities will be incorporated into future plans. The City will establish an Inflow and Infiltration (I/I) Reduction Program that will address wet weather impacts after completion of sewer separation. This potentially could include inflow reduction in the CSO basins serving CSO 202, CSO 203, CSO 204, CSO 208, CSO 210, CSO 211, CSO 212, and potentially other CSO basins in the MRW.

9.8 Summary and Conclusions

As part of the LTCP Update, the City has updated the WWOP to reflect the new facilities. The WWOP is included in Appendix B. The new and existing facilities included in the plan are MRWRRF, PCWRRF, SCRTB, Northeast Omaha RTB, and Leavenworth Storage Tank as well as the various active controls. The WWOP covers pre-event, during-event, and post-event operations for each of the facilities. The plan also includes operations for the various lift stations within the collection system.

This plan will need to be updated as the controls are updated. Throughout the implementation of the LTCP, the City will continue to evaluate methods to maximize use of the existing collection system. This involves evaluating the implementation of RTCs and active controls to maximize flow to both the WRRFs. Implementation of RTCs will likely result in changes to the operations.